Reflections Of A Game Designer: Author Michael Crichton

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• PRINTING MODE	(1) Reversed, Expanded and combination	
	(2) Normal, Expanded, Compressed, Italics, Double Strike, Emphasized, Underline, Super/Subscripts and combination	
• CHARACTER MATRIX	9 x 9	
• CHARACTER TYPES	ASCII	96
	Italics	96
	Semi-graphics	32
	Commodore Graphic	64
• PRINT SPEED	120 CPS	
• LINEFEED SPEED	100 ms	
• THROUGH PUT SPEED	63 LPM	
• COPY	Original + 2	

• NUMBER OF COLUMNS	Normal	80
	Compressed	132
	Expanded	40
	Compressed Expanded	66
• LINE SPACING	1/6", 1/8", 7/72", N/72", N/216"	
• PAPER FEED	Friction Feed	
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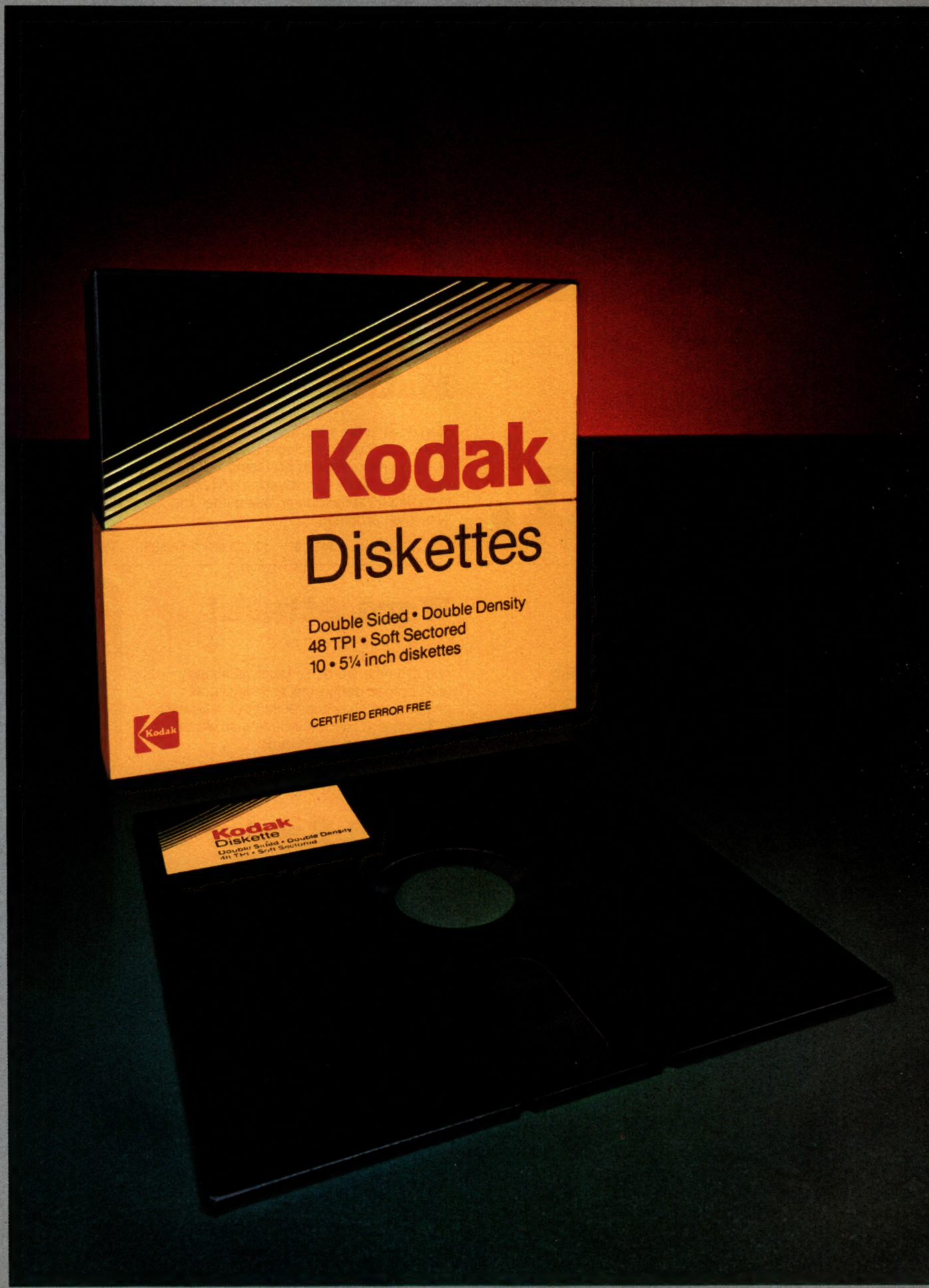
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If you have been looking very long, you have probably discovered that there are just too many claims and counterclaims in the printer market today. There are printers that have some of the features you want, but do not have others. Some features you probably don't care about; others are vitally important to you. We understand. In fact, not long ago, we were in the same position. Deluged by claims and counterclaims. Overburdened by rows and rows of specifications, we decided to separate all the facts — prove or disprove all the claims to our own satisfaction. So we bought printers. We bought samples of all major brands and tested them.

Our Objective Was Simple

We wanted to find that printer which had all the features you could want and yet be sold directly to you at the lowest price. We wanted to give our customers the best printer on the market today at a bargain price.

The Results Are In

The search is over. We hae reduced the field to a single printer that meets all our goals (and more). The printer is the GP-550 from Seikosha, a division of Seiko. We ran this printer through our battery of tests and it came out shining. This printer *can* do it all. Standard draft printing up to a respectable (and honest) 86 characters per second, and with a very readable 9 (horizontal) by 8 (vertical) character matrix. At this rate, you will get an average 30 line letter printed in only 28 seconds.

"NLQ" Mode

One of our highest concerns was about print quality and readability. The GP-550 has a print mode termed Near Letter Quality printing (NLQ mode). This is where the GP-550 outshines all the competition. Hands down! The character matrix in NLQ mode is a very dense 9 (horizontal) by 16 (vertical). This equates to 14,400 addressable dots per square inch. Now we're talking *quality* printing. You can even do graphics in the high resolution mode. The results are the best we've ever seen. The only other printers currently available having resolution this high go for $500 and more *without* the interface or cable needed to hook up to your computer.

Features That Won't Quit

With the GP-550 your computer can now print 40, 48, 68, 80, 96, or 136 characters per line. You can print in ANY of 18 font styles. You not only have the standard Pica, Elite, Condensed and Italics, but also true Superscripts and Subscripts. Never again will you have to worry about how to print H_2O or X^2. This fantastic machine will do it automatically, through easy software commands right from your keyboard. All fonts have true descenders.

One of the fonts we like best is "Proportional" because it looks most like typesetting. The spacing for thin characters like "i" and "l" are given less space which "tightens" the word making reading easier and faster. This is only one example of the careful planning put into the GP-550.

Do you sometimes want to emphasize a word? It's easy, just use **bold** (double strike) to make the words stand out. Or, if you wish to be even more emphatic, underline the words. Or do **both.** You may also wish to "headline" a title. Each basic font has a corresponding elongated (double-wide) version. You can combine any of these modes to make the variation almost endless. Do you wnat to express something that you can't do with words? Use graphics with your text — even on the same line.

You can now do virtually any line spacing you want. You may select 6, 8, 7½ or 12 lines per inch. PLUS you have variable line spacing of 1.2 lines per inch to infinity (no space at all) and 97 other software selectable settings in between. You control line spacing on a dot-by-dot basis. If you've ever had a letter or other document that was just a few lines too long to fit a page, you can see how handy this feature is. Simply reduce the line spacing slightly and ... VOILA! The letter now fits on one page.

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Do you print forms? No problem. This unit will do them all. Any form up to 10 inches wide. The tractors are adjustable from 4½ to 10 inches. Yes, you can also use single sheets. Plain typing paper, your letterhed, short memo forms, anything you choose. Any size under 10" in width. Multiple copies? Absolutely! Put forms or individual sheets with carbons (up to 3 deep), and the last copy will be as readable as the first. Spread sheets with many columns? Of course! Just go to condensed mode printing and print a full 136 columns wide. Forget expensive wide-carriage printers and changing to wide carriage paper. You can no do it all on a standard 8½" page.

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Most printers have a continuous loop ribbon cartridge or a single spool ribbon which gives nice dark printing when new, but quickly starts to fade after a while. To keep the printers' output looking consistently dark, the ribbons must be changed more often than is healthy for the pocketbok. The GP-550 solves this problem completely by using a replaceable, inexpensive ink cassette which is separately replaceable from the actual ribbon. It keeps the ribbon loaded with ink at all times. You only replace the ribbon when it truly wears out, not when it starts to run low on ink. Just another example of the superb engineering applied to the GP-550. (When you finally do wear out your ribbon, replacement cost is only $10.95. Ink cassette replacement cost is only $5.95, both postpaid.)

The Best Part

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February 1985 Vol. 7, No. 2

FEATURES

			GUIDE TO ARTICLES AND PROGRAMS
30	The New Atari: Q & A With Sigmund Hartmann	Tom R. Halfhill and Selby Bateman	*
38	Fame Games	Kathy Yakal	*
44	Michael Crichton: Reflections Of A New Designer	Kathy Yakal	*
48	Birth Of A Computer Game	Sharon Darling	*

REVIEWS

72	*Dinosaurs*	M. C. Ware	AP/64
73	The Syn Series For Atari	Arthur Leyenberger	AT
82	*PC-Write* Word Processor For PC & PCjr	Sheldon Leemon	PC/PCjr

COLUMNS AND DEPARTMENTS

6	The Editor's Notes	Robert Lock	*
10	Readers' Feedback	The Editors and Readers of COMPUTE!	*
105	The Beginner's Page	Tom R. Halfhill	*
117	Programming The TI: Programming Without A Math Background	C. Regena	TI
121	Machine Language: Multiplication, Part 2	Jim Butterfield	*
134	Computers And Society	David D. Thornburg	*
136	IBM Personal Computing: Inside *King's Quest*	Donald B. Trivette	PC/PCjr
139	INSIGHT: Atari	Bill Wilkinson	AT
143	Telecomputing Today	Arlan R. Levitan	*

THE JOURNAL

56	Acrobat	Peter Rizzuto	AT/64/V
88	Plus/Term For VIC & 64	Gregg Peele	V/64
109	Adding Sound Effects To Atari	Matt Giwer	AT
112	How TurboTape Works	Harrie De Ceukelaire, Ottis Cowper, and Charles Brannon	64
123	IBM Rebound: All Machine Language Game For PC & PCjr	Chris Metcalf and Marc Sugiyama	PC/PCjr
126	Apple Bowling Champ	Joseph Ganci	AP
129	Advanced Sound Effects On The 64	Philip I. Nelson	64

145 COMPUTE!'s Guide To Typing In Programs
148 MLX Machine Language Entry Program For Commodore 64 And VIC-20
151 CAPUTE! Modifications Or Corrections To Previous Articles
152 News & Products
160 Advertisers Index

NOTE: See page 145 before typing in programs.

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EDITOR'S NOTES

Senior Editor Richard Mansfield speculates on the perfect computer in this month's guest editorial.
—Robert Lock, Editor in Chief.

Configure, in your mind, the ideal computer. Forget about cost or the limitations of current technology. What would the ultimate thinking machine be able to do? What would it be like?

For example, everyone seems to agree that a perfect automobile would combine the safety of trains with the speed and ease of planes and the freedom and low cost of cars.

In fact, ideal things are generally safe, fast, easy to use, versatile, and cheap. On our planet, many things already qualify: light, water, electricity, TV, some kinds of love, to name a few. Not, however, computers. Not yet, anyway.

If we imagine the qualities of the perfect computer, the first thing that comes to mind is that it should be easy to use, but we have to be careful with this one. What you might find easy to use might perplex or annoy me.

For example, "user-friendly" is a selling point, a current fad, among computer manufacturers. Ads are filled with pop-up menus, windowing, icons, and mouse devices—all ways to make computing possible for nontypists and seductive to noncomputerists. For those of us who have learned to type or to program, however, things like this can sometimes just get in the way. It's far easier, for many people, to simply type LOAD "PROGRAM" than it is to move a mouse to a menu, pull down the disk menu, move to the program name, move the mouse up to the word LOAD, etc.

Perhaps all these features are efforts to make computing easier to learn as distinct from easier to use. But as more people find themselves comfortable working with computers, maybe icons and such won't be as desirable as they now seem.

But what would be the easiest computer to use? Probably one which could communicate in English.

The second quality, safety, is related to ease of use. In computing, a safe environment prevents you from making serious mistakes like erasing an entire disk by accident. Current computers are fairly safe in this respect. But, again, some software goes too far. You can get very frustrated with a program which says ARE YOU SURE?, and then, after you type YES, responds with ARE YOU REALLY SURE?

The safest computer would be able to grasp the context and intent of your actions. If you have been reformatting a number of new disks, it should realize that and dispense with ARE YOU SURE? for each one. Such a computer would have, in effect, common sense.

Speed, in computing, also means more than it first appears to. In many ways, even the most limited computers are now far faster than humans. But a truly quick computer would have the same qualities as a quick person: a fast brain with a large memory. Speed, in this sense, promotes versatility and power.

In some ways, the current trend toward integrated software is an effort in this direction. The larger, faster personal computers are combining word processing, data base management, telecommunications, spreadsheets, etc., into one huge program. It's quite impressive when you can ask your word processor to look over a letter, spend a couple of seconds verifying all the spelling, and then mail the letter for you over a modem.

So, the perfect computer would speak English, have common sense, and be brilliant and versatile. Depending on your personal predilections, such an entity might be indistinguishable from Einstein or Agatha Christie: It would have all of their good qualities and none of the bad; it would be honest, patient, always there. An ideal intellectual companion, a silicon and plastic angel.

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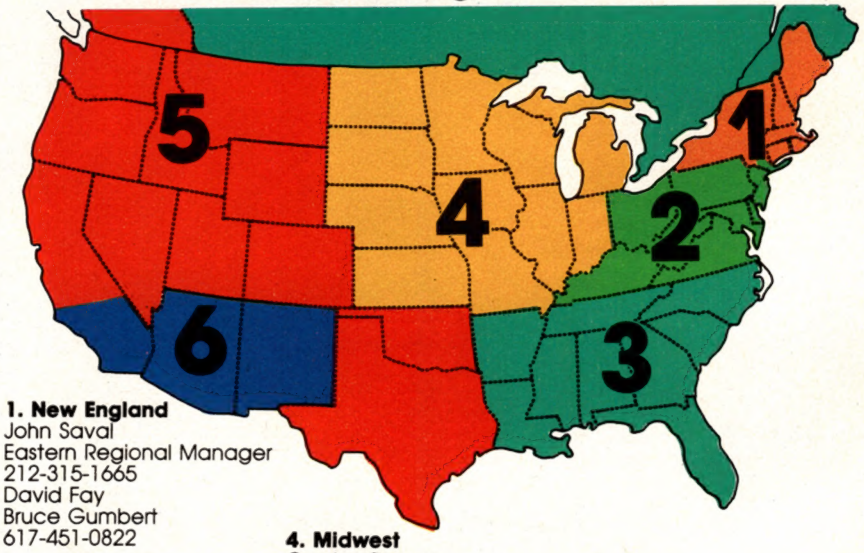

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READERS' FEEDBACK

The Editors and Readers of COMPUTE!

Do You Need Two Disk Drives?

I have a TI-99/4A and an Amdek color monitor. I'm planning to buy a second computer, but I'm confused about the advertising for two disk drives. Why do you need two disk drives?

Natalia Macedo

For many home computer users, one disk drive is sufficient. Two drives are, however, useful in several ways. For example, if you do a lot of disk copying you won't have to keep swapping the disks back and forth.

Some software packages, particularly business programs, require two disk drives. An example would be a data base manager which holds the program disk in one drive and the data disk in the other. Similarly, if you do a lot of programming, you can use two drives to hold your system disk and utilities. Some compilers and assemblers also require or work much faster with two drives.

Many writers prefer dual-disk systems for word processing because they can periodically save backups on separate disks for safety. In general you can live with one and live very well with two.

What Is DOS?

I'm going to buy a disk drive, and different brands of drives have a different DOS. What exactly is DOS?

Ricky Gibbs

DOS (usually pronounced to rhyme with "moss") stands for Disk Operating System. *Basically, this is a program which allows the computer to work with a disk drive. On most computers, DOS lets you save and load files, view disk directories (lists of files stored on disks), rename files, erase files, copy files from one disk to another, copy entire disks, format blank disks (prepare them for use), and other functions.*

There are many different types of DOS for different computers, and they're usually incompatible with each other. It's important that you use the proper DOS for your computer, disk drive, and system configuration. Fortunately, most disk drives (or computers with built-in disk drives) already include the proper DOS.

Usually DOS comes on a disk that must be inserted in the disk drive before you turn on the computer. It loads automatically when the power is switched on. This process is called booting up. *An exception is Commodore DOS, which is stored in Read Only Memory (ROM) chips within the disk drive itself. Commodore DOS is available whenever the computer and disk drive are powered up.*

There are many versions of DOS even for the same computer. As revisions, corrections, and updates are made, new versions of DOS are released, usually denoted by different numbers. Examples are Atari DOS 1 (the original version), DOS 2.0S (improved single-density), and DOS 3 (enhanced density); PC-DOS 1.1 (the original version), DOS 2.0 (with improvements added for hard disks), and DOS 2.1 (modified for the PCjr); Apple DOS 3.3 (originally intended for the Apple II and II+) and ProDOS (introduced with the Apple IIe and IIc); and so on. Commodore DOS is harder to modify since it's embedded in ROM chips, but unofficial updates are usually made when new models of disk drives are introduced.

In addition to the DOS versions released by computer manufacturers, there are also custom versions of DOS sold by independent companies for certain computers. Examples are OS/A+ DOS for Atari computers, CP/M-86 for IBM computers, and CP/M-80 for numerous personal computers. Sometimes a custom DOS is compatible with the manufacturer's DOS, and sometimes it requires extra hardware (such as a CP/M board).

The disk drive you buy for your computer will probably come with the right DOS for your system. If it doesn't, the dealer can recommend the proper DOS or a compatible custom DOS.

The Great Commodore Save/Replace Debate

I have a Commodore 64 and a 1541 disk drive. Recently I saved a program on a disk and later saved another program on the same disk. When I

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tried to load the first program, I was surprised to get the second instead! What happened? How can I get my first program back?

Jason Stearns

Assuming there's no mysterious hardware error, it's possible that you saved the second program with the save/replace command (SAVE "@0:filename",8). When you precede a filename with the at sign (@), the computer first saves the new file with the same filename before erasing the old file. The purpose of save/replace is to make it easier to update files on a disk in one step. (Some computers do this automatically.)

The save/replace command is a controversial subject among some Commodore users. For years it's been rumored that save/replace contains a bug which can scramble programs and disks, but it's unpredictable and therefore very difficult to confirm. Usually it seems to happen when you are using a disk with less than 100 blocks free. We recently lost a file after using save/replace and spent hours trying unsuccessfully to duplicate the error.

One programmer, convinced that save/replace works, has offered a reward to anyone who can prove otherwise. COMPUTE!, *however, has concluded that where there's smoke, there might be fire; mangled disks can be so frustrating, lost files can be so difficult to replace, we don't think the added convenience of save/replace is worth the risk.*

To be safe, avoid using save/replace. Instead, save the program with a different filename, maybe with a .V2 extender (for version 2). The next file can be .V3, etc. Then rename the file after you have a final debugged version and delete all the early versions.

Your first program was probably still recorded on the disk after it seemed to disappear, but to recover it you would need a disk editor utility. Such a utility lets you read the directory map and change the byte which signifies a deleted file. However, even this works only when you haven't saved any other files on the disk in the meantime. It's also easy to destroy other files if you aren't sure how to use the utility.

It's a good practice to always save copies of important programs and data files on backup disks which are stored away from your main disks. If you upgraded to disk from tape, you can also save backups on your old cassettes.

BASIC Translations

I recently bought a Timex Sinclair 2068 computer and was disappointed when I could not find any software. I even tried typing in Atari and Commodore programs from COMPUTE!, but was unsuccessful. What should I do?

Wagih Mando

You'll have to stick to relatively generic BASIC programs—those that have few or no PEEKs, POKEs, graphics, or sound commands (which are nearly always machine-specific). You could, of course, translate the sound and graphics commands of other computers into the corresponding Sinclair BASIC statements, but this can be difficult, especially if you're not familiar with the other program and computer.

Programs written for earlier models of Sinclair computers should translate fairly easily for the 2068—but again, avoid programs with many PEEKs, POKEs, and machine language subroutines. Naturally, these programs won't take advantage of the 2068's new features, including color graphics.

COMPUTE! *has not published any programs for Sinclair computers for quite a while, but copies of* Creating Arcade Games on the Timex Sinclair *are still available from COMPUTE! Books. Although it's aimed primarily at users of the Sinclair ZX-81 and TS-1000, some of it would apply to your 2068.*

Atari Amnesia

I recently bought an Atari 800XL which claims to have 64K, but which seems to have only 48K user memory. The other 16K supposedly is available only with certain software programs. Which ones? I am also having trouble with the memory test. The other day I bought a game requiring at least 48K. I tried to load it on my 1050 disk drive, but the picture is distorted. I tried again, but got the same results. So I tried the memory test by holding down the OPTION key while turning on the computer. The ROM checks green. So does all my RAM, up to 44K. I checked it again, still 44K. What do I do?

Steve Whitlow

It sounds like your computer is behaving normally, but the software may not be compatible with the 800XL. Check with the dealer who sold you the program or with the software publisher. Some programs designed for the older Atari computers have trouble running on the newer XL machines because of changes in the computer's operating system. The fault still lies with the software, though, because from the beginning Atari made it clear that programmers should follow certain rules to insure compatibility with future models.

One solution might be to obtain a translation disk which, in effect, temporarily converts your XL into an older-model Atari 800. The disks are available from Atari for a nominal fee and from some independent companies.

The memory discrepancies you discovered are unrelated to the software problem. The Atari 800XL does indeed have 64K of Random Access Memory (RAM), but as with the Commodore 64 and 64K Apple

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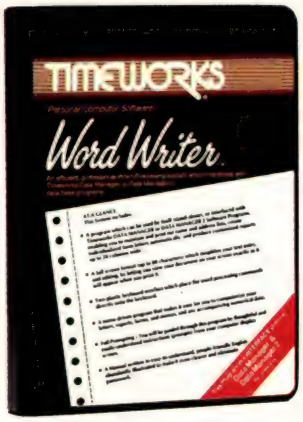

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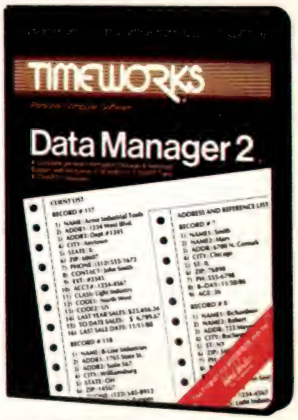

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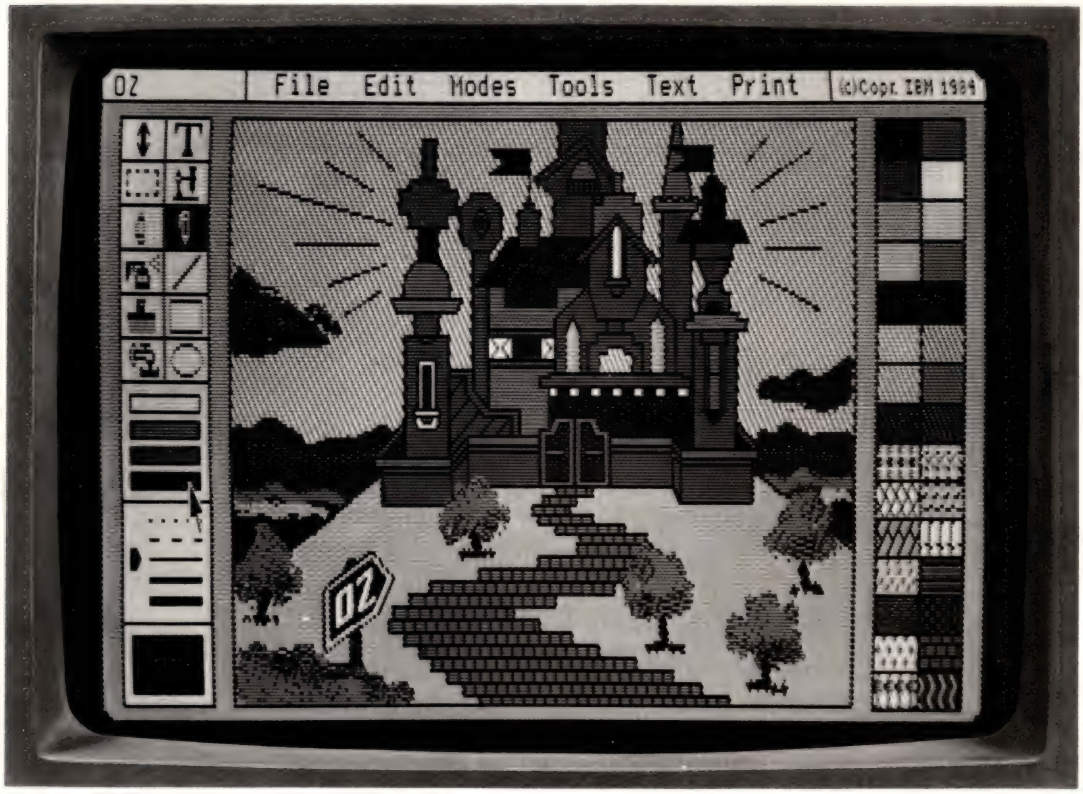
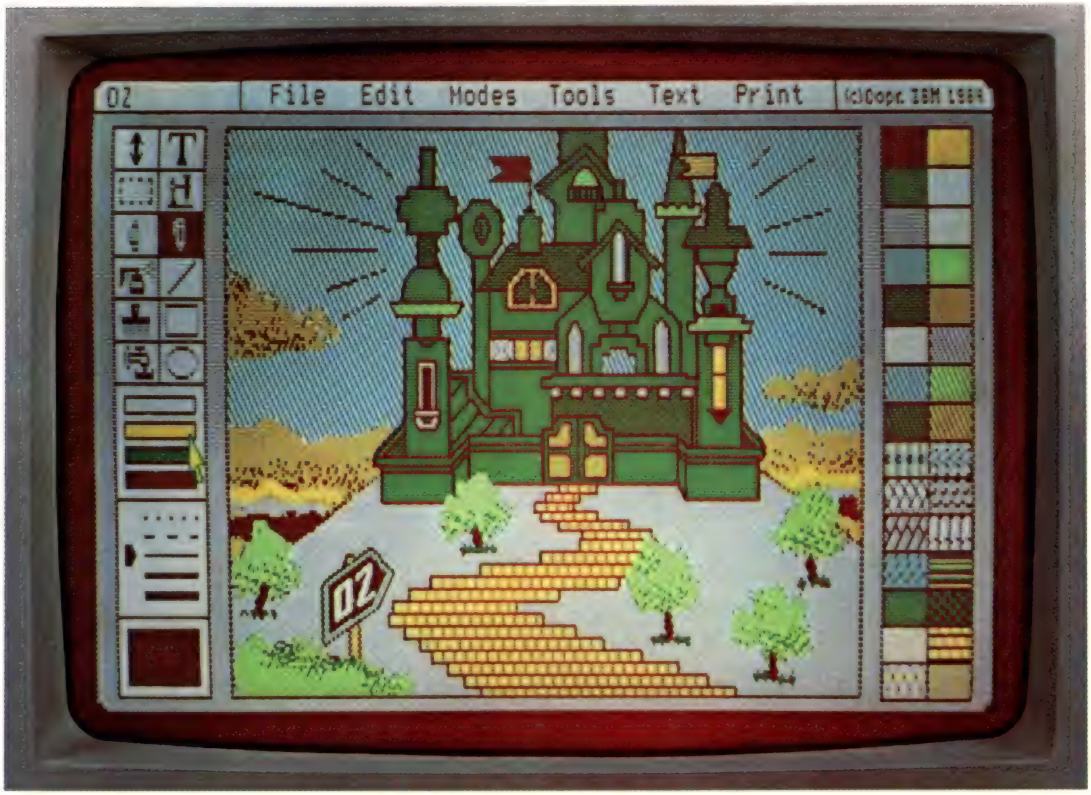


it's more fun in color.



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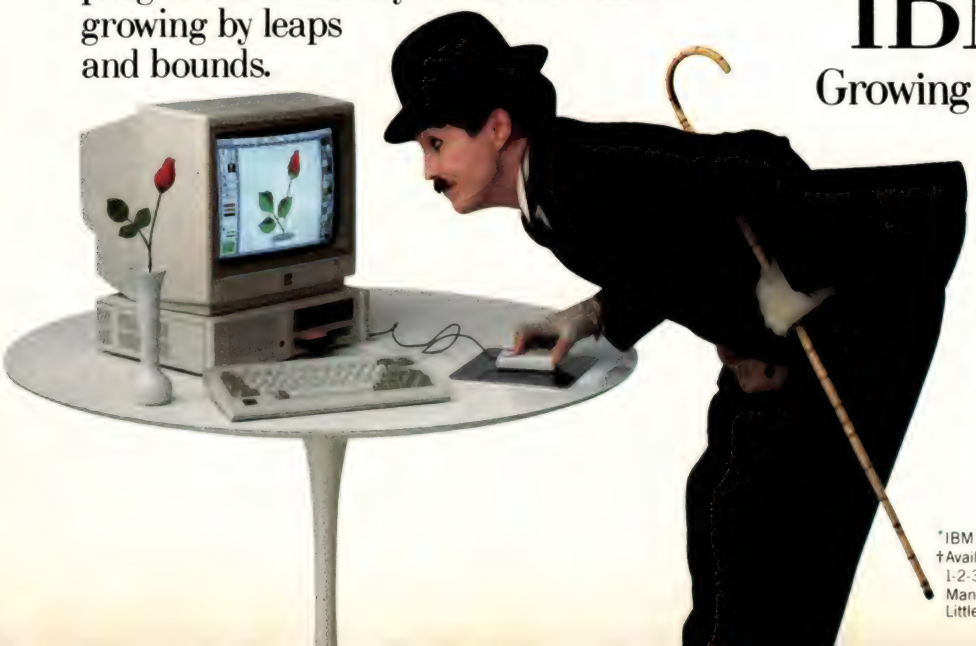

*IBM Product Center prices. Computer price does not include monitor.
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IIe, not all of this RAM is immediately accessible. All these computers use 6502-family chips for their Central Processing Units (CPUs). The 6502 is limited to accessing, or addressing, *a total of 64K of memory at a time. Part of this 64K must be allocated for internal programs necessary to operate the computer. This includes the operating system and BASIC language.*

The Atari operating system, stored in Read Only Memory (ROM), requires 10K of space. Additional ROM space is used for the international character set and self-test routines. BASIC, when selected, uses a little over 8K of space. The input/output chips need 2K of address space, since they are controlled as if they were memory locations. This leaves less than 40K of RAM when using BASIC. Roughly the same amount of memory is available for BASIC on a Commodore 64 or 64K Apple IIe.

If you switch off BASIC in your 800XL (equivalent to unplugging the BASIC cartridge on the older Atari 400, 800, and 1200XL computers), 48K of RAM is directly addressable. To switch off BASIC, hold down the OPTION button when powering up.

Don't think you're being misled by the 64K RAM claim; it's there, but it takes some special programming to access it. Not many commercial programs take advantage of this extra memory, though, because they would not be compatible with the large number of older 800s still in use.

If you have some programming experience, you can reach this additional memory with your own programs. The PIA chip in your Atari, used for the two joystick ports, also helps control memory mapping and other special XL functions. These functions are controlled with memory location 54017 (PORTB, $D301), formerly used on the 400/800 to read joystick ports 3 and 4, which are omitted on the XL models. (Incidentally, if you try to read the shadow registers for joysticks 3 and 4, or use STICK(2) or STICK(3) in BASIC, the values returned will be those of joystick ports 1 and 2.) The eight bits at $D301 control eight functions (see chart).

Add up the decimal values of the functions you want to enable or disable, then store the sum into location 54017. Of course, you would not want to turn off BASIC or the operating system with a POKE from BASIC (without a language, operating system, or controlling program, the computer would be reduced to a prism of pure memory with nothing to remember). Feel free to flicker the LEDs (found only on the 1200XL) from BASIC, but memory mapping should always be done with a machine language program.

With both BASIC and the operating system disabled, there is free RAM from $A000 to $FFFF, 16K of additional RAM space. Well, almost 16K. The computer is pretty useless without its video and input/output chips, so they are kept active from $D000 to $D7FF, leaving this 2K of RAM inaccessible.

If you're going to tackle the job of accessing all of the Atari's hidden RAM, there's another consideration, too. The video chip generates a nonmaskable interrupt (NMI) every 1/60 second so that the operating system can update screen variables. This NMI cannot be disabled, so if the operating system is out to lunch when the interrupt happens, the 6502 tries to make an indirect jump through the NMI vector at $FFFA, finds nothing of value there, and crashes. So before you switch out the RAM, write the address of a nominally functional NMI routine into $FFFA and $FFFB. This can simply point to an RTI (return from interrupt) so that NMIs will be ignored.

Remember also that with the operating system and interrupts disabled, you cannot make use of any of the shadow registers for input/output. You must store directly into the hardware locations. And naturally, you have to reenable the operating system to call routines like CIO (Central Input/Output).

Bit Position	Bit Value	Decimal Equivalent	Function
0	0	0	Disable operating system ROM, enable RAM from $C000 to $FFFF.
0	1	1	Enable OS ROM (default).
1	0	0	Disable built-in BASIC ROM.
1	1	2	BASIC off, RAM on at $A000-$BFFF.
2	0	0	Turn on LED #1.
2	1	4	Turn off LED #1.
3	0	0	Turn on LED #2.
3	1	8	Turn off LED #2.
4-6	-	-	Not presently used.
7	0	0	Enable self-test ROM.
7	1	128	Disable self-test ROM, enable RAM at $5000-$57FF (default after power-up complete).

Using The Commodore Wedge In Your Programs

Many people incorrectly state that DOS 5.1 commands don't work in program mode. The commands not only work, but can be used to do some things which would be difficult or impossible to do from BASIC. It's only necessary to enclose the operand in quotes. For instance:

```
10@"IO"
20@"$"
```

This will initialize the disk drive and list the disk directory without disturbing the program in memory. Other possible uses for the Wedge in program mode exist.

Dave Palmer

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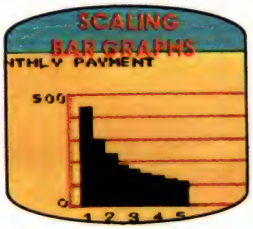

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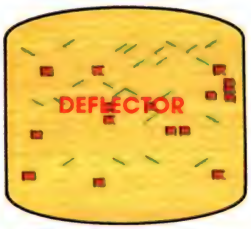

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Thanks for sharing the information. It's also helpful to begin your program with a loader routine that installs DOS 5.1 so you don't have to remember to load the Wedge each time. In addition, this keeps other people who may use your program from complaining about the inexplicable crashes they may encounter otherwise. Make sure DOS 5.1 is on the same disk as your loader routine.

TI POKE?

I own a TI-99/4A and would like to know if there is an equivalent for POKE in TI BASIC or TI Extended BASIC.

Paul Parks

There is no equivalent for POKE or PEEK in standard TI BASIC. This is one example of how TI BASIC differs considerably from other personal computer BASICs. The language designers may have felt that PEEK and POKE commands—which allow programmers to examine and modify individual memory locations—were somehow risky tools to put in the hands of inexperienced programmers. Of course, many inexperienced programmers progress beyond that stage and would find uses for these commands. Constructing a blockade between the programmer and the lower levels of the machine can severely limit a user's control.

Fortunately, TI's Extended BASIC does provide an equivalent for POKE, the CALL LOAD statement. For example, to place the value 100 in location 20000, you'd use CALL LOAD(20000,100). The equivalent to PEEK is CALL PEEK. To place the value from location 20000 into the variable X, you'd use CALL PEEK(200000,X).

Remember that memory for the video display is maintained separately from the microprocessor (and, without expansion, BASIC programs are actually stored in the video memory area), so CALL LOAD and CALL PEEK give you access only to the processor memory or to any attached expansion memory. The ROM in the Mini Memory *cartridge also provides for CALL LOAD and CALL PEEK, and in addition provides CALL POKEV and CALL PEEKV, which allow you to store and retrieve data from video memory.*

TI also supplies an impressive library of built-in subroutines that accomplish many of the things that PEEK and POKE are used for on other computers. For example, to read the TI joysticks, you can type:

```
100 CALL JOYST(1,X,Y)
```

Other valuable features are CALL CHAR, RESEQUENCE, and NUMBER. These provide built-in character redefinition, renumbering, and automatic line-numbering utilities.

Apple Shape Tables

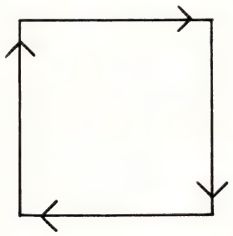
I have an Apple II+ and have been trying to figure out shape tables. How do the data numbers affect a shape? How do the numbers in the DRAW and XDRAW commands make a shape?

Tony Steele

Shape tables can appear very confusing, but they are extremely useful, though in some cases it may be easier to draw complicated figures with HPLOT.

Basically, a shape table contains plotting vectors to draw a figure. Each vector describes the movement necessary to draw the object.

Let's try constructing a shape table to draw a square to see how it all gets done. The first step is to draw the shape on a piece of paper.



Now you must convert the figure to coded plotting vectors. Vector codes are numbers between 0 and 7 which correspond to a direction of movement, and each byte of a shape definition can hold as many as three vectors. The task now is to reduce the shape to a series of vectors, then place these vectors into memory, where they can be used to draw shapes.

Pick a starting point on the figure you want to code. For our square, we'll start at the bottom-left corner. Make a list of the directions required to draw the shape. Be sure you include all movements necessary, even those not actually drawn on the screen.

Starting at the bottom-left corner, we need these vectors to draw our square:

Vector	Plot
up	yes
right	yes
down	yes
left	yes

Now use this table to write the proper binary code next to each vector:

Action	Binary Code	Decimal Code
move up without plotting	000	0
move right without plotting	001	1
move down without plotting	010	2
move left without plotting	011	3
move up with plotting	100	4
move right with plotting	101	5
move down with plotting	110	6
move left with plotting	111	7

COLOR

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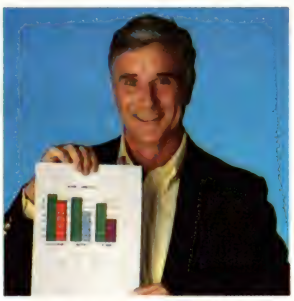

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You should now have a table that looks like this:

Vector	Plot	Code
up	yes	100
right	yes	101
down	yes	110
left	yes	111

The Apple stores information in memory in bytes of eight-bit binary numbers. Usually two, and sometimes three, plotting vectors can be stored in a specific memory address. A memory byte can be thought of as:

7 6	5 4 3	2 1 0
A	B	C

There are a few rules to follow when packing binary codes into memory:
1. All bytes are read from right to left.
2. When all remaining sections of a byte contain zeros, the rest of the byte will be ignored.
3. Only a move instruction may be placed in section A of a byte.

Now refer to your table and place the binary code for the first vector into section C of the first byte, and place the binary code of the second vector into section B of the byte.

In section A of each byte, a zero always means no movement and no plotting, and a zero value will be ignored by BASIC. The only legal vectors in section A are right, left, and down without plotting. No other plotting vectors are allowed in section A.

The byte should now look like this:

7 6	5 4 3	2 1 0
A	B	C
0 0	1 0 1	1 0 0

Notice that the vector for move right with plotting was not placed into section A. Start filling in the next byte with the remaining values.

7 6	5 4 3	2 1 0
A	B	C
0 0	1 0 1	1 0 0
0 0	1 1 1	1 1 0
0 0	0 0 0	0 0 0

This is the table for drawing the square. After each byte has been filled in, set the last byte to zero. This signals BASIC that the end of the shape table has been reached.

Divide the byte into two four-bit portions (nybbles) and convert the nybbles to hexadecimal numbers:

Binary		Hex
0 0 1 0	1 1 0 0	2 C
0 0 1 1	1 1 1 0	3 E
0 0 0 0	0 0 0 0	0 0

The only information needed to complete the shape table is the Shape Table Directory, which contains the number of shape definitions in the table and which points to a starting location for each shape.

The first byte of the shape table contains the number of shape definitions. The second byte is unused, and starting with the third byte, a table of indices to the starting addresses of each shape definition is stored. This value is the offset that must be added to the starting address of the table to obtain the starting address of a specific shape.

Using the example of our square, we'll store the shape table starting at $1F00. The completed shape table looks like this:

1 F 0 0	0 1	
1 F 0 1	0 0	Directory
1 F 0 2	0 4	
1 F 0 3	0 0	
1 F 0 4	2 C	Shape Definition
1 F 0 5	3 E	
1 F 0 6	0 0	

This shape table may be stored in memory using the monitor, or by POKEing the values from a table of DATA. The starting address of the shape table must be stored in memory location $E8. Again, you can place it there with the monitor, or by entering the following in immediate mode:

```
POKE 232,0
POKE 233,31
```

That completes the shape table, and you're ready to save the table and DRAW, XDRAW, ROT, or SCALE to your heart's content.

Atari Self-Loading Tapes

I have tried to load a machine language cassette tape by holding down the START button while turning the machine on, waiting for the beep, and hitting RETURN. The program starts loading into the machine, but I get a BOOT ERROR message. Why? What is the proper way to do this?

Geoffrey C. Bennett

Two possibilities exist. The most obvious explanation is that your tape is defective. But it is more likely that you have a disk drive attached and turned on. After the tape is successfully loaded, the Atari then tries to boot the disk drive. With no disk in the drive, you get the BOOT ERROR. Turn off

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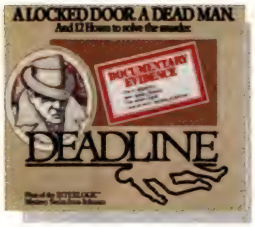
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the drive or disconnect it when you load a boot tape.

Also, many machine language programs on boot tapes won't work with the BASIC cartridge plugged in. Try removing BASIC before loading the tape into Atari 400, 800, and 1200XL computers. On a 600XL or 800XL, you can disable the built-in BASIC by holding down the OPTION button. (Therefore, to auto-boot with a 600XL or 800XL, you would simultaneously hold down OPTION and START while switching on the computer.)

Simultaneous Commodore Graphics And Text

I'm writing an adventure game and would like to mix text with graphics. Is there any way I can divide the screen to leave four lines at the bottom for text?

Peter Goldstein

You didn't mention which computer you're writing your game on, but we'll assume it's the Commodore 64. The Apple, Atari, IBM, and TI have this capability built into BASIC and require no special programming.

On the 64, the best way to divide the screen into two (or more) parts is to use a programming technique called a raster interrupt. *Raster interrupts take advantage of the sequential nature of a video image. The image is painted on the screen by a cathode-ray beam which always begins at the top-left corner and sweeps across the screen left to right. When the beam reaches the right edge of the screen, it's turned off for a split second and returned to the left side of the screen. Then the beam is dropped down one line and the process is repeated. When it finally reaches the bottom-right corner of the screen, it's switched off again and returned to the starting position at the upper-left corner. The entire cycle repeats 60 times a second.*

On the Commodore 64, you can determine which horizontal line the beam is currently scanning by reading the raster register *at location $D012 (53266). With this information in hand, you can write a program to interrupt the process so you can insert a few lines of text or change screen colors.*

However, this takes some advanced programming. The raster interrupt can't be accessed directly from BASIC, because BASIC must be turned off to insert a vector to your interrupt routine.

Here's a demonstration program which loads a machine language routine into memory and allows you to change screen colors and split the screen. To use this routine in your own programs, simply change lines 20 through 50 to define the variables to suit your needs.

```
10 GOSUB130                              :rem 117
20 INPUT"SELECT TOP SCREEN COLOR: ";A
                                         :rem 222
30 INPUT"SELECT BOTTOM SCREEN COLOR: ";B
                                         :rem 194
40 PRINT"WHAT ROW FOR SCREEN DIVISION?"
                                         :rem 172
50 INPUTC:IFC<10RC>23THENPRINT"VALID RANG
   E IS 0-23{2 SPACES}RE-ENTER":GOTO40
                                         :rem 140
60 SYS49152                              :rem 106
70 POKE829,A:REM SET TOP SCREEN COLOR
                                         :rem 226
80 POKE830,B:REM SET BOTTOM SCREEN COLOR
                                         :rem 190
90 POKE831,21: REM TOP SCREEN UPPERCASE/G
   RAPHICS                               :rem 188
100 POKE832,23:REM BOTTOM SCREEN LOWER CA
    SE                                    :rem 70
110 POKE828,50+C*8:REM SET DIVIDING POINT
                                         :rem 166
120 STOP                                 :rem 217
130 CK=0:FORI=49152TO49247:READA:CK=CK+A:
    POKEI,A:NEXT:IFCK=10244THENRETURN
                                         :rem 180
140 PRINT"{RVS}ERROR IN DATA STATEMENTS":
    STOP                                  :rem 59
150 DATA120,169,127,141,13,220           :rem 231
160 DATA169,1,141,26,208,173             :rem 145
170 DATA60,3,141,18,208,169               :rem 96
180 DATA27,141,17,208,169,34             :rem 151
190 DATA141,20,3,169,192,141             :rem 141
200 DATA21,3,88,96,173,18                  :rem 1
210 DATA208,205,60,3,208,28               :rem 87
220 DATA169,0,141,18,208,173             :rem 142
230 DATA64,3,141,24,208,173               :rem 89
240 DATA62,3,141,33,208,169               :rem 93
250 DATA1,141,25,208,104,168             :rem 137
260 DATA104,170,104,64,173,60            :rem 187
270 DATA3,141,18,208,173,61               :rem 93
280 DATA3,141,33,208,173,63               :rem 93
290 DATA3,141,24,208,169,1                :rem 43
300 DATA141,25,208,76,49,234             :rem 147
```

For a thorough discussion on using raster interrupts, see "Split Screens" and "Son of Split Screens" by Jim Butterfield in COMPUTE!'s First Book of Commodore 64.

Atari Modem Update

Your reply to Paul S. Reyes in the November 1984 "Readers' Feedback" column does not appear to be very timely or accurate. The modem currently offered by Atari is the model 1030 direct-connect, autodial, autoanswer modem. If your statement "the Atari modem comes with its own software, but is not compatible with other modem software" is about the 1030, you are incorrect.

Versions of Jim Steinbrecher's AMODEM 4.8, a public domain program, have been specifically written for use with the Atari 835 and 1030 modems, as well as modems connected through the Atari 850 Interface Module. The version I have is called RMODEM and is available on many bulletin boards and from the CompuServe

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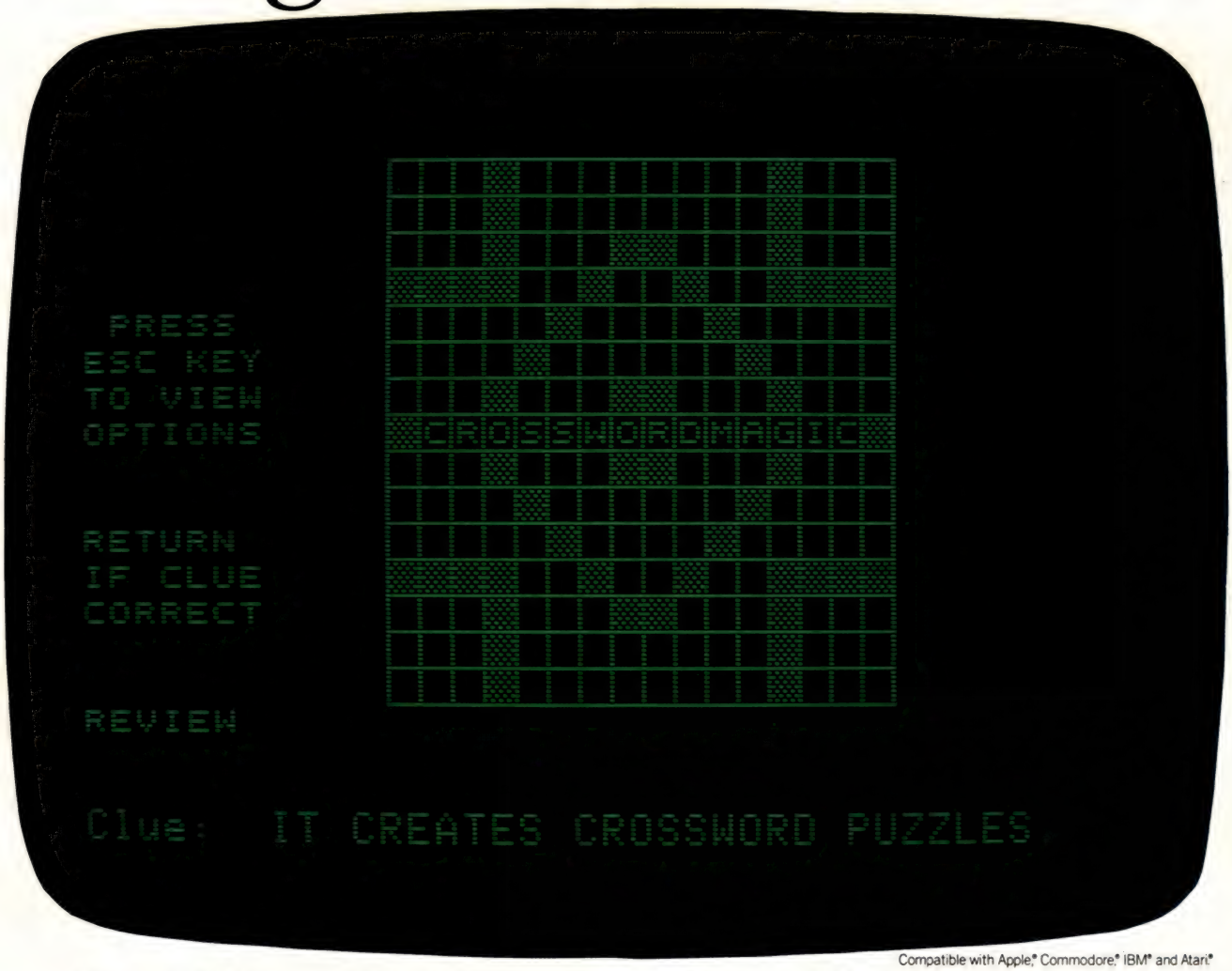

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Information Service. RMODEM can be compiled, and it provides a 22K buffer that can be dumped to your disk drive or printer.

The Atari 1030 modem has been advertised by a national chain store on sale at $69.96. At that price it is certainly a best buy.

Note that the Atari 1030 modem uses the T: handler as opposed to the R: handler for the 850 Interface Module. Both handlers are supported by RMODEM.

Howard Stebbins

Thanks for this additional information. COMPUTE! *stands by its answer, though, since many Atari owners may lack the programming skill to modify modem programs using the R: device that were written before the introduction of the 1030. In fact, the JTERM Atari terminal program published in last month's issue of* COMPUTE! *was written for modems which use the R: device, not the T: device.*

Apple Joystick To Keys Conversion

I use an Apple II+ for games and educational programming, and would like to change games which require a paddle to keyboard input. How can I do this?

Michael Weaver

Applesoft BASIC has a very handy statement (PDL) for reading the value of the game controller, and you can also read the keyboard buffer to see which key is being pressed (although it's not as handy). The GET statement can read the keyboard, too, but it halts the program while waiting for input.

To convert a program from using a game controller to the keyboard, find all the routines which read PDL, then change those routines to read the keyboard buffer instead. Try using this subroutine:

```
10 A =  PEEK ( - 16384)
20 B =  PEEK ( - 16368)
40  IF A < 128 THEN 10
50 D = A - 128
60  IF D = 65 THEN  PRINT "RIGHT"
70  IF D = 68 THEN  PRINT "LEFT"
80  IF D = 87 THEN  PRINT "UP"
90  IF D = 88 THEN  PRINT "DOWN"
100  IF D = 32 THEN  PRINT "FIRE!"
110  GOTO 10
```

This checks for the ASCII values of the A, D, W, X, and space bar, and ignores all other keys. Line 10 reads the keyboard and line 20 resets the keyboard to await the next keypress. Line 40 evaluates A to see if a key was pressed. If bit 7 is set (the value of A is greater that 128), then a key was pressed. Line 50 translates the value of A to an ASCII value, and lines 60 through 110 evaluate the key pressed. Of course, these lines could be changed to read any keys, and values could be included to check for diagonal movement (the Q, E, C, and Z keys).

Be advised, however, that Apple paddles are resistive, so they return numeric variables that do not correspond directly to directions. The keyboard routine presented above provides for reading directions and is thus not a perfect replacement for an Apple paddle.

Faulty Math?

I have a Commodore 64, and there seems to be an error of some kind in the math logic. If you raise the number 5 to the power of 7 (PRINT 5↑7), you get the result of 78125.0001, which is incorrect.

I have found this error with other numbers, and although these amounts are small, I'm afraid there are others which I haven't found yet which are causing errors in math programs. Could you tell me what causes this?

Bill Briggs

You have come across the phenomenon known as rounding error. *Most home computers use the binary system for mathematical calculations. While some fractional numbers translate easily to binary, some do not. The same is true of decimal numbering, the system we're used to. The fraction 1/3 translates into 33 percent (after rounding off all those extra threes). And three times 33 percent comes to 99 percent. The result is off by 1 percent.*

You will never be able to translate 1/3 into a perfect percentage in decimal. And your computer will never be exactly accurate when it uses certain functions in binary. But how do fractions occur when raising one whole number to the power of another whole number?

If you were trying to do the expression you mentioned on paper, you'd write 5 × 5 × 5 × 5 × 5 × 5 × 5. However, the computer uses a more sophisticated mathematical formula to avoid having to perform the repeated multiplications. To see how it works, try entering the following line in direct mode:

```
PRINT EXP(7 * LOG(5))
```

Notice that this gives the same answer as PRINT 5↑7. It's the fractions involved in evaluating the logarithm (LOG) and exponential (EXP) functions that lead to the rounding error. Other functions that suffer the same problem for a similar reason are SIN, COS, TAN, ATN, and SQR.

For a thorough discussion on rounding errors, see "De-Bugging BASIC, Part 2," in the February 1985 issue of our sister publication, COMPUTE!'s GAZETTE.

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Apple Emulator For Commodore 64?

I have heard of an add-on system for the Commodore 64 that will allow you to use any of the Apple hardware and software on the 64. What is it?

Jason Meudt

When the 64 was first introduced, there wasn't very much software available for it, but Apple had thousands of programs available on just about every subject imaginable. It wasn't long before rumors began circulating about an Apple emulator which plugged into the 64 and turned it into an instant Apple. Some companies even advertised them and took orders. As far as we know, none was actually delivered.

The problem of one computer emulating another is complex. Besides having to duplicate the functions of the operating system of the computer being emulated, you must also have a disk drive which can read the other system's disks. Commodore's 1541 normally can read only those disks formatted on disk drives compatible with the 1541, not Apple disks. Hence, you'd need an Apple-compatible disk drive. Even though both the Apple and Commodore use a 6502-family microprocessor, you must still have Apple DOS and a different operating system. All that remains of your original 64 is the keyboard, some RAM chips, and the microprocessor. Therefore, an Apple emulator for the 64 would end up costing almost as much as an Apple purchased outright.

There's also a possible legal complication. Apple has been very aggressive in bringing lawsuits against vendors who market products with ROMs that Apple feels are close copies of its own operating system. For example, Apple successfully fought a long legal battle with the makers of the Franklin Ace computer. Since the emulator would have to provide an operating system that closely resembled Apple's, it's quite possible that the manufacturer would end up in court.

Moreover, new programs for the 64 have been published or released commercially on almost a daily basis since the 64 was introduced. By now most of the original Apple library has been translated for the 64, with enhancements to take advantage of the 64's more advanced sound and graphics capabilities. Thus, much of the original impetus for the development of an emulator has dwindled. In fact, with the booming library of original software for the 64, a 64 emulator for the Apple might prove more popular.

Nevertheless, one Apple emulator is currently being advertised in COMPUTE!, *though at this writing it is not yet available. Mimic Systems Inc., 1112 Fort St., Fl. 6M, Victoria, B.C., Canada V8V 4V2, has announced an Apple emulator and plans to have it ready for the Winter Consumer Electronics Show in January, with sales to begin early in 1985. Mimic's current price estimate is around $600. For comparison, the Apple IIe is presently available for about $800.*

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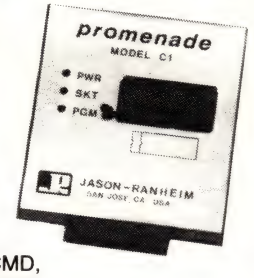

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TI Rounding Routine

Here's a routine for TI-99/4A users that will round off decimal points to any desired place.

Bill Gardella

```
100 N=0
110 D$=STR$(C)
120 N=N+1
130 E$=SEG$(D$,N,1)
140 IF E$="" THEN 250
150 IF E$<>"." THEN 120
160 E$=SEG$(D$,1,N+2)
170 F$=SEG$(D$,N+3,1)
180 IF F$="" THEN 200
190 G=VAL(F$)
200 H=VAL(E$)
210 IF G<5 THEN 230
220 H=H+.01
230 C=H
240 GOTO 270
250 H=VAL(D$)
260 C=H
270 REM Rest of program from here o
    n.
```

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Q&A

The New Atari

With Sigmund Hartmann President Of Atari Software

Tom R. Halfhill, Editor, and Selby Bateman, Features Editor

Sigmund Hartmann

Sigmund Hartmann was born in Germany, educated in Belgium and the United States, and is one of the few people who have worked for the volatile Jack Tramiel three times—twice at Commodore, and now at Atari. Before joining Commodore for the first time, Hartmann worked at TRW, a major high-technology corporation. His first stint at Commodore as general manager didn't gel, so he returned to TRW. In all, he spent 18 years at TRW, working as an engineering manager for NASA space projects and running a division which included hundreds of engineers and programmers. In 1983, Hartmann rejoined Commodore to head Tramiel's newly formed software division. But in early 1984, after a management dispute, Tramiel shocked the industry by leaving the company he had founded in the 1950s and buying Atari—ironically, a firm he had nearly destroyed in the home computer price war of 1982–83. Several top executives and engineers loyal to Tramiel left Commodore in the months afterward and followed their former boss to Atari. In late 1984, Hartmann crossed over, too, taking command of the remnants of Atari's software division.

COMPUTE! *caught up with Hartmann in November at the COMDEX/Fall computer show in Las Vegas soon after his move. Hartmann was accompanied by two of Tramiel's sons, who now hold top positions at Atari. Although Hartmann had just begun to immerse himself in the herculean task of rebuilding Atari, he agreed to discuss the company's future plans and the new computers it hopes to introduce at the Winter Consumer Electronics Show (CES) in January. It was almost two months before CES, and Hartmann had few technical details, but he was willing to sit down for 20 minutes and sketch out the most important points in his heavy European accent.*

Atari is pegging its comeback on the release of three new machines in the first half of 1985: a 128K RAM, upward-compatible version of the existing 800XL; a powerful 16/32-bit computer built around the Motorola 68000 microprocessor found in the Apple Macintosh; and a superpowerful, full 32-bit machine with perhaps as much as 1000K of RAM (one megabyte). All will be mass-marketed, and the latter two are

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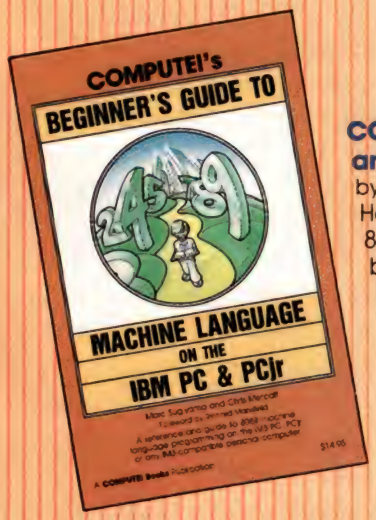

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At least one of the advanced computers also will feature a new operating system licensed from Digital Research—CP/M-86K—and Digital Research's GEM (Graphics Environment Manager). GEM shields users from the operating system with icons, pull-down menus, and a mouse controller, as on the Macintosh. (COMPUTE! *will have more details on the new computers and operating systems after CES.)*

One week before this interview, Atari had slashed prices on its existing hardware and software to boost Christmas sales and raise much needed cash. List prices (before dealer discounts) were cut to about $120 for the 64K 800XL and $199 for the 1050 disk drive. Prices of other peripherals and software were substantially reduced, too.

Although this interview was conducted in a limited amount of time, Hartmann's comments reveal much about his own plans and Jack Tramiel's new direction for Atari.

Q&A

Hartmann: Can I give you a preview of why I joined the company? The major reason I joined Atari is because, knowing Jack, working for him—this is my third time with Jack—and knowing the type of individual he is—that he is a successful individual—I joined a team of people which I worked with previously. And those people are the ones who took Commodore to one billion dollars. So if you are a smart guy, what you do is you join that team, the winning team, and now you take the new company up to a billion-plus. We learned a few things and we should do better than a billion dollars, for certain. So that is one of the major reasons, and Jack and I were always close. Plus the timing was right. And that's why I took the job.

Since I am heading software worldwide for Atari, which includes AtariSoft, the strategy is to continue to sell software for non-Atari products. So we want to continue to sell all types of software packages for the PC, for the Apple, for the Commodore, for every machine. In addition to that, we will also sell, under AtariSoft, peripherals which are non-Atari peripherals. So we are going to be totally in the business of selling software products but also peripheral products and accessories for non-Atari machines.

C!: What kind of peripherals might that include?

Hartmann: Printers, disk drives, etc. OK? So that is the strategy which we are going to follow. In addition to that, if you look in the past of the Atari Corporation, the old Atari, the main emphasis was to be recognized as a game company. We definitely want to change that. We are definitely going to be and will be a microcomputer company. And if you look up microcomputer, it says you've got to have the computer technology, you've got to have software with it, and you've got to have peripherals. We are going to concentrate on all those three areas.

In terms of the existing machine, we have an 800XL machine which you've heard about. That 800XL was cost-reduced. Because of the way we cost-reduced it and eliminated some of the components, we had an opportunity to increase the reliability of it, so we cost-reduced it and maintained compatibility. And as you know, when you reduce parts in a piece of equipment, the reliability goes up. What we did is we took some of the components and made them a gate array. Gate arrays are more reliable types of devices, OK? So we reduced the price to below $120—I think you know that. But in addition to that, we geared up our manufacturing to produce a few hundred thousand or more a month. So it's going into high production. And there is no intention of phasing that machine out. It's going to be going on for quite a long period of time. So it's going to be huge for the after-market.

From what I can see, with our new pricing structure, we are already seeing a trend that people are buying it. They're buying our disk drives, which we reduced the price also now, which is below some other company which we are competing with. So Jack did what he said he would do. He started the trend of moving the company to where it is going to be a superprofitable company.

C!: Those are very attractive prices and you've answered a lot of questions for people.

Hartmann: But in addition to that, we are also coming out with another 800 machine which will have 128K of RAM, which is really what you need, OK?

C!: Will that be compatible with the older Atari computers?

Hartmann: It's going to be upward-compatible totally with the 800XL machines. We're going to stick with a consistent capability in terms of compatibility. We do not want to lose that software base out there.

C!: What other improvements will this machine have?

Hartmann: There are other ones but I cannot tell you now. . . . The big thing is to give you more memory.

C!: What is the price going to be?

Hartmann: It will be probably just a little higher, but I do not know now. It's like the philosophy of Jack Tramiel is to make certain that the end-user gets tremendous value for his money. So the price is going to

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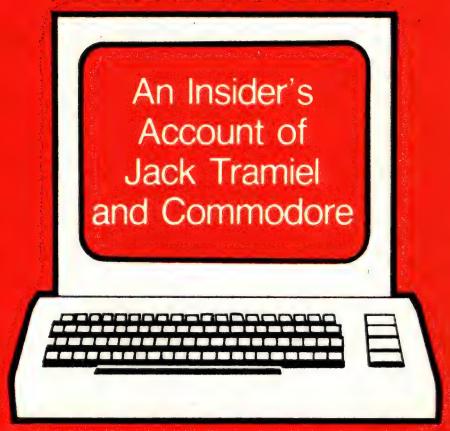

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be way low in comparison to our competition, for example.

C!: Is there going to be a different name for this?

Hartmann: Yeah, we'll have a name for it, but right now we don't have anything. At CES we'll have a name to identify it.

So much for what I call the low-end machine, except for one other thing. In terms of the software for the 800XL, what I'm looking for—and I did discuss a lot of this with third-party software developers—I'm hoping we are going to come out with a whole slew of third-party software pieces, but the major emphasis being placed not on recreational or game software, but productivity software and educational software. Because as I pointed out before, if you look at Atari in the old days, it was mainly recognized as a game [company] and they had some excellent game software. I'm pushing the pendulum that other way—education, productivity software. And still do games and recreational software. But the best we can buy we can get. I'd rather have less and have quality.

Another very important emphasis which Jack is placing on all of his guys is quality. He feels that quality comes first for a very simple reason. We didn't start this company to be there for one year, go public, and then get out. We are here for the long haul, and in order to take it up to the billions which we want to take it, you need to establish yourself as a quality house. So Jack is really tough on everyone. He wants to make sure we do not ship a product which does not meet the highest quality standard. Very important. And that goes true with software, peripherals, and so on. And that is so much for the 800-series machines.

Now, let's go up to new products. Jack announced that we would have two machines

Q&A

"We are gearing ourselves to produce half a million computers a month."

coming out and we'll probably demonstrate at least one of them during CES. That is our 16-bit machine. Now again, everyone says "16-bit" and starts to look at what processor we'll be using. The processor which we're using is really a 68000 Motorola processor, which is really—if you look at the advertising by Macintosh, by Apple—a 32-bit machine. But we don't want to play games, so we say that it is truly a 16-bit machine. From a viewpoint of what you can do with it, it isn't a full-blown 32-bit, so we call it a 16-bit machine.

Now, that machine is going to use as its foundation the GEM hookup. Digital Research came out with GEM. You've heard of Crystal, it's like the Macintosh type. It's a graphical representation of what I call an extension of an operating system. It gives you icons, it gives you graphic representations, pull-down menus, and everything, with a mouse—you use a mouse with it. It's like the Macintosh. Now, we signed a deal with Digital Research, and worked with Digital Research for quite a while. We're using, actually, their operating system, the CP/M-86K, that's the operating system which we're using, OK? And we're using their GEM program. And we're working very closely with Digital Research to get that product completed so that we can demonstrate it at CES.

C!: But CP/M-86, isn't that an operating system for the eight-bit Z80 chip?

Hartmann: That's *K*, CP/M-86K. That's what they call a Macintosh-type operating system. . . . In my opinion it's just fantastic.

C!: GEM isn't running on any computer right now, is it?

Hartmann: Oh, yes, you could see it, they have it at Tandy . . . pull-down menus, mouse, everything, like the Macintosh, basically. [Editor's note: This is the MS-DOS, IBM-compatible version of GEM.] We believe if you look at the machine in terms of resolution, graphics, it's going to be very powerful. It's going to have features which in my opinion are going to be better than what the Macintosh features are. So that machine will be available, and we'll demonstrate it in January, and within a few months we'll start to ship it. When I say "a few months," it's tough to predict exactly. I would say within three months or so we'll ship it, I would say not later than that.

C!: But you'll be demonstrating it at CES?

Hartmann: Yes, I would say we'll be demonstrating it at CES. OK, then the next question would be, How are you going to sell it? All of our 16- and 32-bit machines will be sold through the mass merchants. The price structure is going to be below $1,000. It is going to be so significant in terms of reduction, that we believe that we will really get a big share of the marketplace. If you look at it, really, with the introduction of the 16-bit machine, we are gearing ourselves to produce a half a million computers a month. That's what Jack Tramiel, what

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Atari is doing, gearing ourselves to produce that many. And as far as we are concerned, price performance is going to be there, the quality of the product is going to be assured, the software will be available on the 16-bit machine. I've been talking in the last few days to third-party software developers, trying to get them to be partners with us. But more important, our philosophy is to give them the development tools, give them all the help possible so they can develop software and they can sell it themselves if they want to. So it's an open system. A similar philosophy with the Macintosh, really, which Apple followed. Different than what I used to do at Commodore. OK? And it makes sense, you have to look at time. When you bring out a 16/32-bit machine, you have no other choice, you have to operate that way.

C!: Are you getting many takers on this third-party software?

Hartmann: The guys I talked to felt that it sounded very interesting. They also recognize when Jack makes up his mind to do something. So they all said they want to continue talking to us. Some of them will definitely port over the system to our machine, 'cause they've got it running on the Macintosh and they will do it for us. And then we'll decide if they want to sell it to us, or give us a license, or if they're going to sell it themselves. But we do have companies which will do it for us. I can't tell you who yet, because I just talked with them in the last couple of days. And when I get back to my office, we'll continue and get all the data, the specifications, and turn it over to the people.

C!: There are supposed to be two new computers out for Atari next year, a 16-bit machine and also a 32-bit. What's the next machine out?

Hartmann: The 32-bit machine, we don't want to tell you yet what the processor is on it. It's going to be coming out about two or three months later, after CES, and you can guess what kind of processor you'll have to put in it. There are many full-blown 32-bit processors. I'll give you a couple of choices which I have in my mind. One is the 68020, which is the Motorola. Another one you can look at is the National, which is the 32032. And then you have Intel and I don't know how many more. But there are a couple of them, and I'm sure you can add a couple of more to them. And we will make our software and write our system in such a way that we can pick either of the two architectures and still make it work. So we have a little time to think about which system to use. We'll make that decision probably within the next four to six weeks.

C!: If we could come down to Atari sometime in December before CES and take a look at these, because we have a very loyal Atari following and I think they're looking for what's going to come. Plus a loyal Commodore following which is interested, too. . . . Now, the two new computers—these are very powerful computers, more powerful, obviously, than an IBM PC. Will they be marketed as home computers or business computers or something in between?

Hartmann: I'll tell you what Jack says. He doesn't care. He says he sells them. If a guy wants to buy them for home uses, wants to buy them for personal business, wants to buy them to run his business, that's fine. But we'll have the proper support there, we'll have the right software there.

C!: So the 32-bit machine also will be at the mass merchants?

Hartmann: All mass merchants. I'm telling you, below $1,000.

C!: For both machines? How much memory will the 32-bit machine have?

Hartmann: I can't tell you that, but it has to be sufficient for people to use it.

C!: OK, now you'll mass-merchandise them, but if it's available in K marts and places like that—

Hartmann: But you have to look at K mart. How about if I tell you K mart may have a computer store?

C!: Like Sears, OK. But will people take seriously for business purposes a computer that's mass-merchandised?

Hartmann: But we are not saying that it should only be for business. Only that a guy can buy a 32-bit machine.

C!: You're saying an under-$1,000 computer for anyone who wants to buy it, mass-merchandised.

Hartmann: And he can either use it for business, either use it for his home—have fun, do anything—it's up to him. We don't want to tell the guy, "Hey, this is only a business machine."

C!: Right, but at the same time, you can also use a 64 or an Atari 800XL for some businesses, but no one takes them seriously because they're sold as home computers.

Hartmann: That's why the software. That's why if you look at GEM, and you look at the application software which we'll have with the machine, it's going to be so friendly and so wonderful to use, it's going to make a lot attractive. You don't need all the jillion pieces of support, you don't need a thick manual, like *this* thick. It'll be a lot simpler. ©

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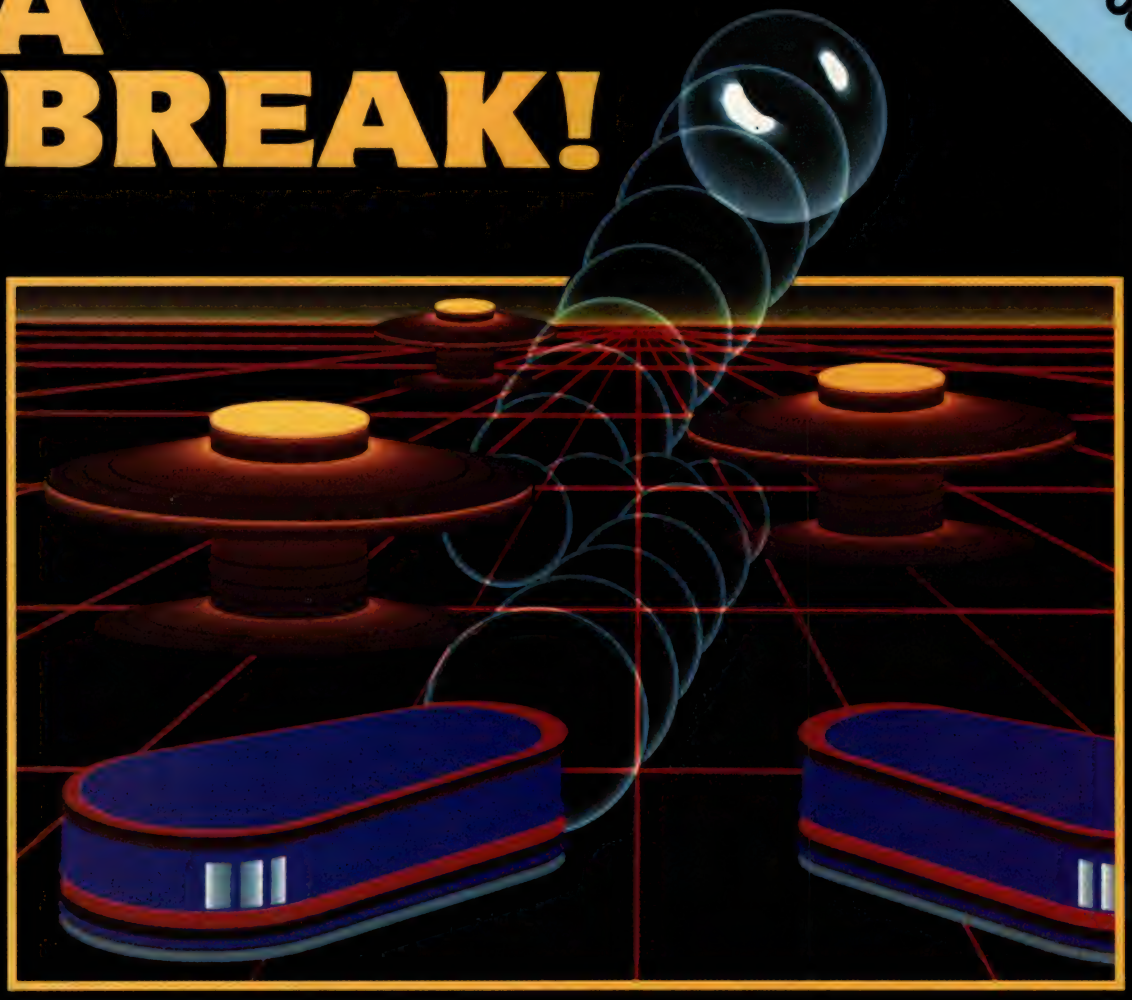

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Fame

Kathy Yakal, Feature Writer

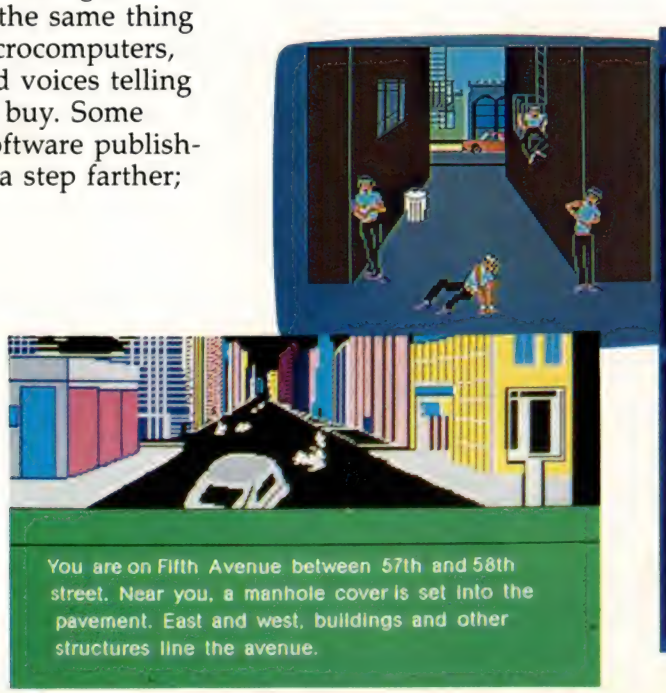
Though some authors and stars are lending only their names to entertainment software, others are actively contributing to the game's design. Here's a look at what's happening.

You see it practically every time you flip through a magazine or turn on the television. Fame lending its name to the cause of advertising. Tennis players and movie stars and race-car drivers hawking shampoo and sports equipment and clothing lines.

We've seen the same thing happen with microcomputers, famous faces and voices telling us which one to buy. Some entertainment software publishers are taking it a step farther; instead of promoting a package, the personality is a major part of the software, either as one of the game's characters, or even its designer.

The Trillium series, produced by a division of Spinnaker Software, is one of the best examples of this trend. It's a series of interactive adventure games for the Commodore 64 and Apple II-series computers, based on novels by well-known science fiction authors.

In each of the games, the

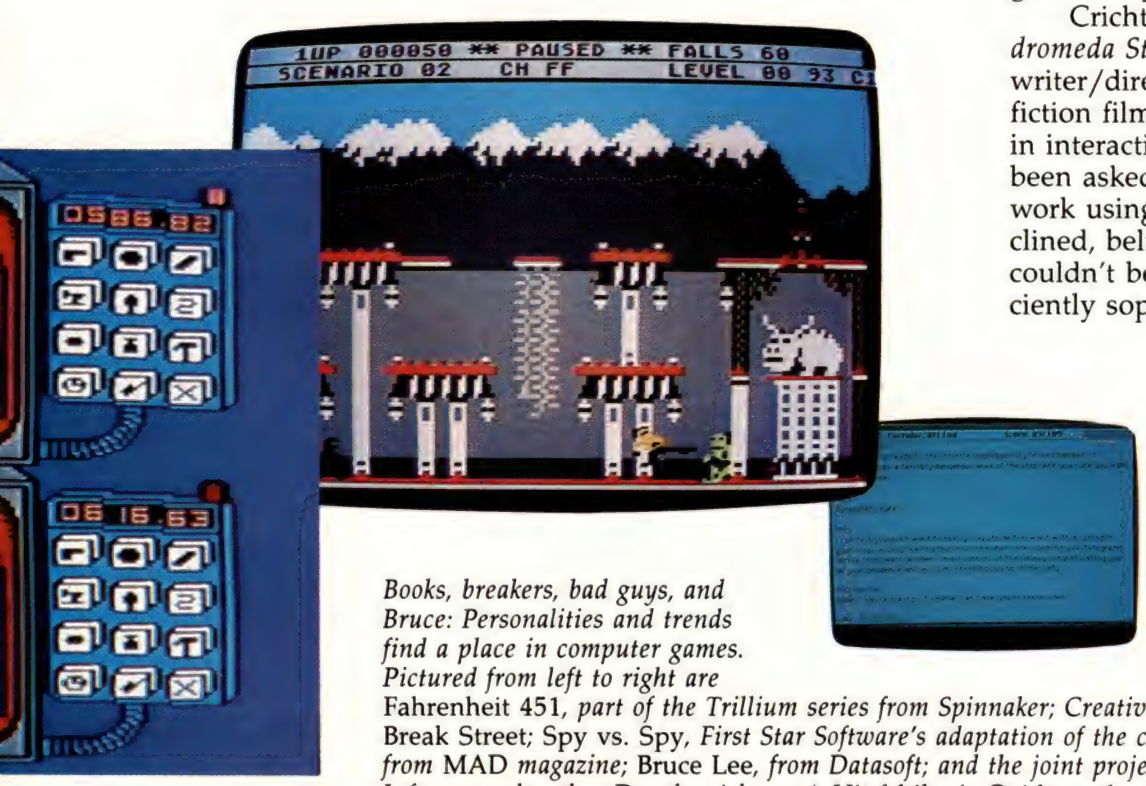

You are on Fifth Avenue between 57th and 58th street. Near you, a manhole cover is set into the pavement. East and west, buildings and other structures line the avenue.

Games

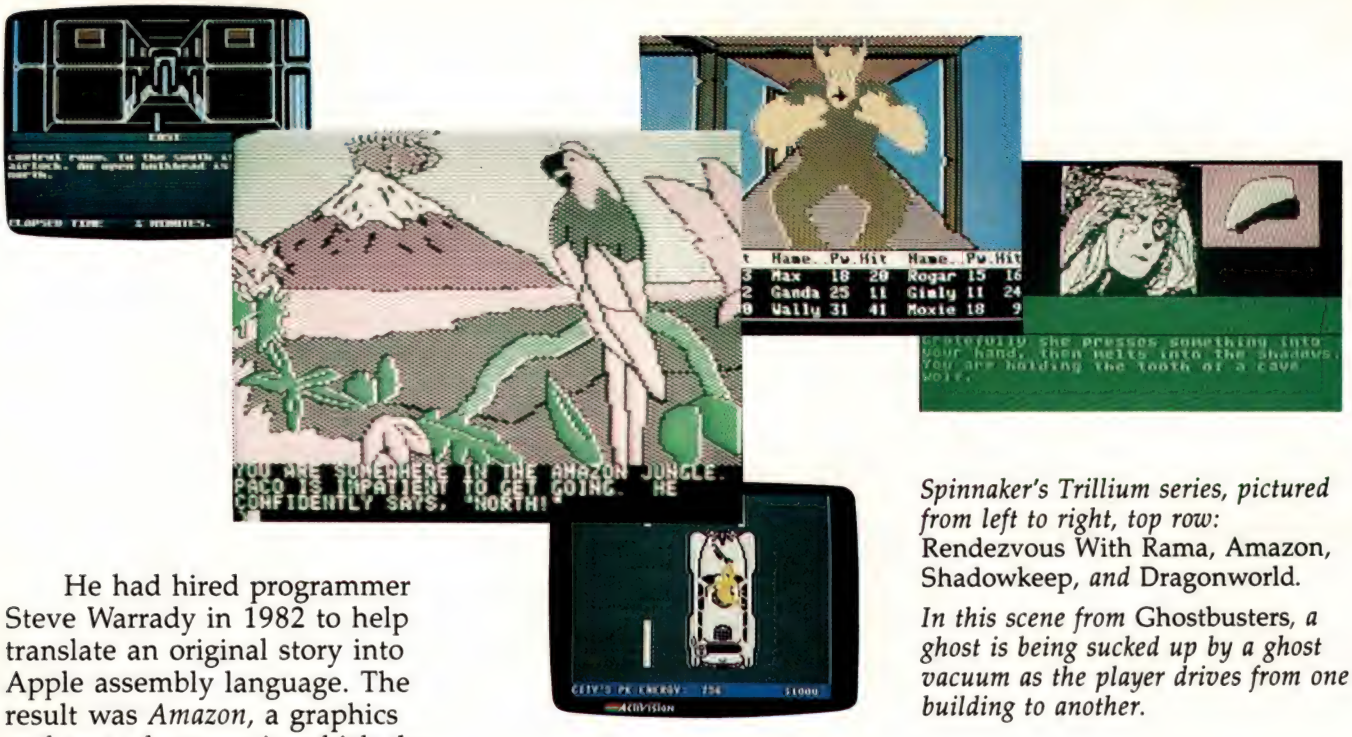
player takes the role of the novel's main character, encountering his or her problems and making decisions. Full-color graphics and a sophisticated parser that understands several hundred words make the games easy to play. A hint book and word list are included in each package.

In late 1983, Spinnaker approached writer Michael Crichton, thinking that some of his works might lend themselves well to adventure games. He surprised them. He was just completing work on an adventure game of his own. "They came to acquire book rights and ended up taking a finished game," says Crichton.

Crichton, author of *The Andromeda Strain* and *Congo*, and writer/director of many science fiction films, was very interested in interactive fiction. He had been asked to do some creative work using laser disks but declined, believing that they couldn't be accessed in a sufficiently sophisticated fashion.



Books, breakers, bad guys, and Bruce: Personalities and trends find a place in computer games. Pictured from left to right are Fahrenheit 451, *part of the Trillium series from Spinnaker; Creative Software's* Break Street; Spy vs. Spy, *First Star Software's adaptation of the comic strip from* MAD *magazine;* Bruce Lee, *from Datasoft; and the joint project of Infocom and author Douglas Adams,* A Hitchhiker's Guide to the Galaxy.


Name. Pw.Hit Name. Pw.Hit
Max 18 20 Rogar 15
Ganda 25 11 Gimly 11
Wally 31 41 Moxie 18
YOU ARE SOMEWHERE IN THE AMAZON JUNGLE.
PACO IS IMPATIENT TO GET GOING. HE
CONFIDENTLY SAYS, "NORTH!"
ACTIVISION

Spinnaker's Trillium series, pictured from left to right, top row: Rendezvous With Rama, Amazon, Shadowkeep, *and* Dragonworld.

In this scene from Ghostbusters, *a ghost is being sucked up by a ghost vacuum as the player drives from one building to another.*

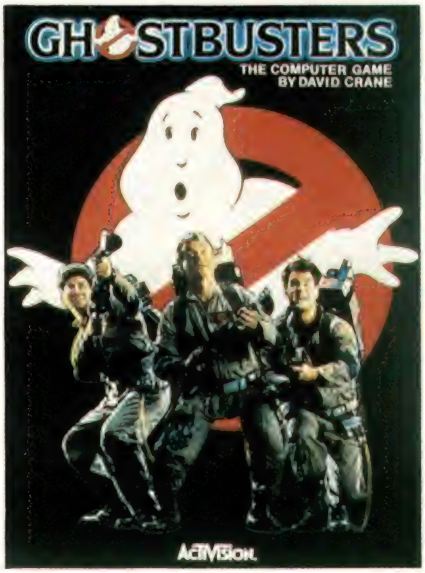
He had hired programmer Steve Warrady in 1982 to help translate an original story into Apple assembly language. The result was *Amazon*, a graphics and text adventure in which the player is an agent for NSRT, a high-tech research firm. The player must travel to the Amazon and recover valuable emeralds hidden in the Lost City of Chak, with the help of a friendly (and often sarcastic) bird named Paco.

Fahrenheit 451, another game in the Trillium series, is a sequel to Ray Bradbury's book of the same name. As Guy Montag, the player lives in a future totalitarian society whose government is committed to controlling the populace by destroying all literature. Montag's mission is to restore to the world the freedom it once had.

Rendezvous With Rama is based on the Arthur C. Clarke novel. The player, as captain of a small scout spaceship which has just encountered an alien starship hurtling into the solar system, must explore it and try to make contact with alien intelligence. (Clarke wrote a new ending to be used in the game.)

The fantasy *Dragonworld*, by Byron Preiss and Michael Reaves, sends the player on a journey to rescue The Last Dragon from the Duke of Darkness.

And here's an interesting twist: Science fiction writer Alan Dean Foster wrote a novel based on the fantasy game *Shadowkeep*. The player's task is to recapture the Shadowkeep, with its mazes and monsters, and to free the good wizard Nacomedon. Up to nine characters may be chosen by the player while exploring the keep. Designed as an interactive adventure, the game incorporates many aspects of role-playing fantasy software.



Who ya gonna call?

Software designer David Crane, a cofounder of Activision, went to see the movie *Ghostbusters* on the recommendation of a friend. "I think I may have enjoyed it a lot more than some people because it was sprung on me," he says. "From the first special effect, you knew that there was something here that wasn't just stand-up comedy."

Two days after he saw the movie, someone at Activision asked if he'd like to write a computer game based on the movie. He took a day to think about it. "To do justice to any game takes no less than 500 hours of my time, and I was going to get married in six weeks."

His decision to do it was based partly on the fact that he had already been working on the game without knowing it. For a couple of months, Crane had been trying to develop a game that had something to do with equipping a car and driving it around city streets, but it was going nowhere. "It was a game concept in search of a theme," he says.

And the *Ghostbusters* theme

["Hi, we're from Europe. Where's the gold?"]

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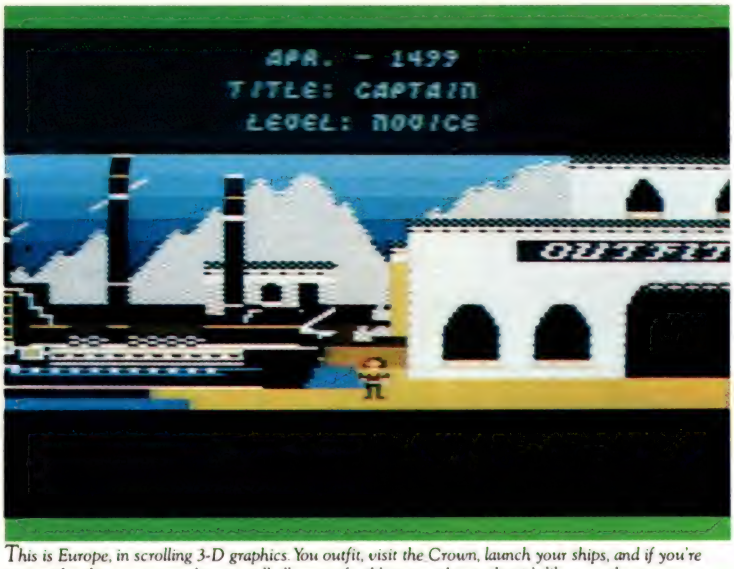
It's a kind of adventure. An unusually rich and technically impressive one with new continents to explore, natives to encounter, resources to manage and trade routes to establish. But beyond all the neat stuff *Seven Cities* throws up on the screen, there's something else happening here.

It feels quite odd to look at the map and see nothing. Of course you have to explore the more than 2800 screen new world in order to map it. But the way the natives act, the way you get older, the way seasons change and your men behave, and the way your reputation preceeds you gives you a sort of feeling that's unexpected in computer games. It's deeper. Maybe a little disquieting. It plays as much in your head as it does inside your computer.

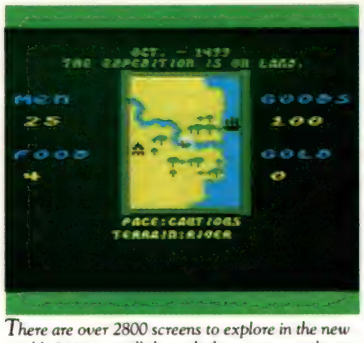
Seven Cities does all this with the real world or, better still (since the "new" world really isn't anymore), it will construct any number of completely detailed hemispheres for you to try your hand with.

Designed by Ozark Softscape (the people who made M.U.L.E., *Infoworld's* "Strategy Game of 1983"), *Seven Cities* is about as near a recreation of history as has ever been accomplished, with or without a computer.

Find it. Stomp around in it. See if you can't do a better job than all the celebrated figures who got us into the mess we have to deal with today.

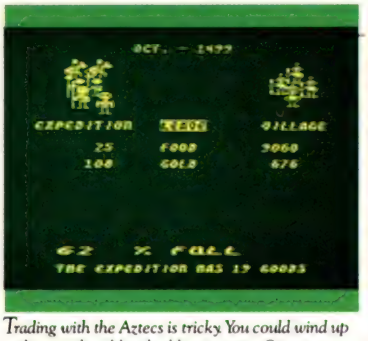


This is Europe, in scrolling 3-D graphics. You outfit, visit the Crown, launch your ships, and if you're cut out for this, you return later to tell all sorts of wild stories about what it's like over there.



There are over 2800 screens to explore in the new world. As you scroll through them, seasons change.

Animated natives surround you. They have no reason to trust you. The drum beat quickens.



Trading with the Aztecs is tricky. You could wind up with enough gold to build an empire. Or as soup.

Home again you view your maps, pat yourself on the back, and consider your place in history.

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fit perfectly. The theme song from the movie plays throughout the game (you can sing along by following the bouncing ball at the game's opening) as you buy a car and outfit it with equipment like ghost bait (to trap the marshmallow man) and a ghost vacuum (to suck up ghosts as you drive through the streets of the city). Buildings flashing red are ghost-ridden, and it's your job to maneuver each ghost into a ghost trap before he "slimes" you. The game is won when you've captured enough ghosts to enter Zuul.

"It's an amazing coincidence that what I was doing followed the script of the movie. I was able to put the theme and game together in such a way that I could have what's really an original game concept that embodied the spirit of the movie."

There were no coincidences involved in the development of Infocom's computer game version of *A Hitchhiker's Guide to the Galaxy*, just a lot of mutual admiration. "Most people at Infocom were *Hitchhiker's* fans, and Douglas Adams [author of the book] was an Infocom game player," says Steve Meretzky.

A Hitchhiker's Guide to the Galaxy is the story of Arthur Dent, an ordinary human being who is thrust into some rather extraordinary circumstances. After being told by Ford Prefect (an alien in disguise) that the earth is about to be destroyed, he hitches a ride on a Volgon spaceship, where he is tortured by having poetry read to him. Surviving that, he is ejected into space, and is rescued by the *Heart of Gold*, another spaceship, and brought to the planet Magrathea. Improbable things continue to happen as the zany plot unfolds.

Meretzky, a program designer for Infocom, and Adams worked together to translate the book's themes, characters, and humor into a text adventure. "The game starts out following the book pretty closely, up to your arrival on the Volgon ship," he says. "From that point, until you get to the *Heart of Gold*, the general story line is pretty similar, but a lot of the more specific things that happen aren't the same things that happen in the book.

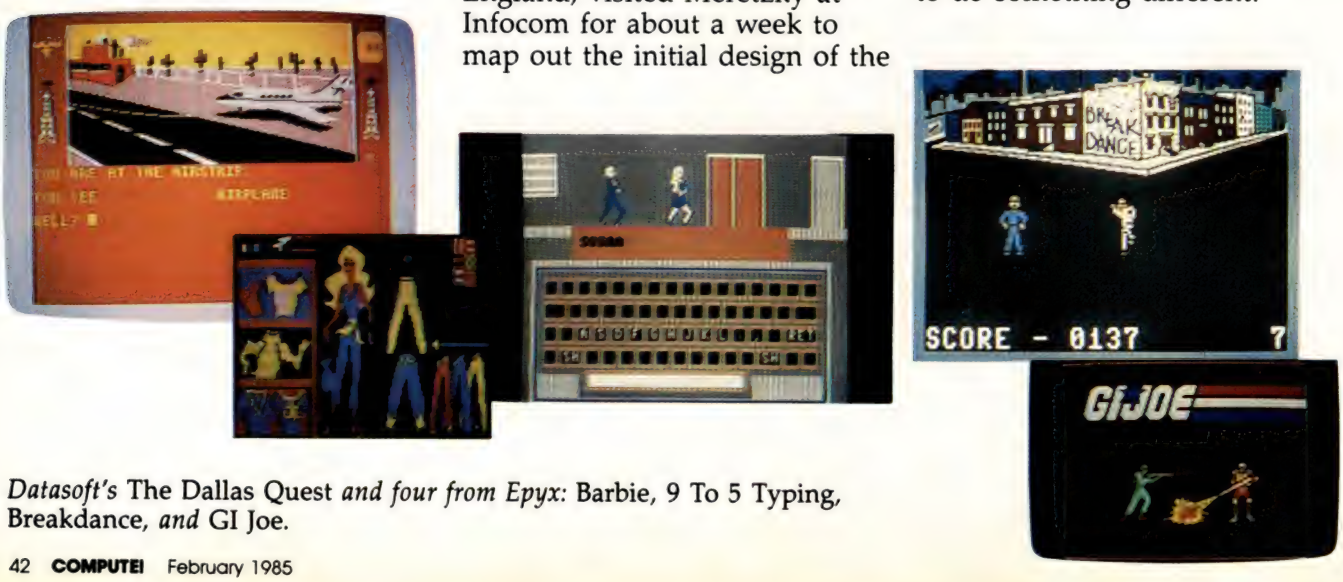
"By the time you get to the *Heart of Gold*, the story diverges almost completely from the story line of the book. But there are a number of things that are just sort of alluded to in the book that are gone into in much more detail in the game."

Adams, whose home is in England, visited Meretzky at Infocom for about a week to map out the initial design of the game. They found that their creative styles differed. Meretzky, who had previously designed *Planetfall* and *Sorcerer* for Infocom, usually came up with an overall concept for a game, then went back and filled in details. Adams did it the opposite way—details first.

So they kept in constant contact via electronic mail as Meretzky was programming, then met again in England for some intense final sessions ("We basically holed ourselves up in a country inn and didn't come out until we had finished").

Meretzky found a different kind of challenge in programming a game whose story line had basically been written by someone else. "In some ways it's easier, and in some ways it's harder," he says. "It's easier because you have some constraints on the universe you're going to be designing, and on the characters you're going to be using, and a lot of the situations, and you don't have to come up with as many ideas.

"But on the other hand, there's more of a challenge because you want to take advantage of the features of an interactive game, and you don't want it to be just a translation of the book, because the book is necessarily linear. You want to take advantage of the features and the power of the computer to do something different."



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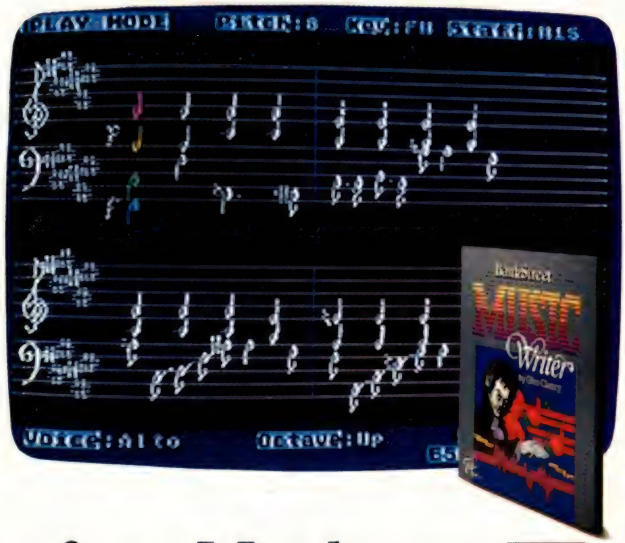

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Michael Crichton

Reflections Of A

There are new ways of presenting information other than the traditional ways in which the viewer or reader is required to be passive. A few years ago, I realized that I didn't know about these things, and that I'd better find out about them. The only way I could learn was to actually go and do one. So I said, "Well, I'll just make a game and then I'll learn." And I certainly did.

Interactive fiction—the adventure game—is one of those new ways. And Michael Crichton is one of the newest authors in this genre.

Crichton is better known for his work in fiction and films. His novels include *The Andromeda Strain, The Terminal Man,* and *Congo.* As a filmmaker, he has been involved in the writing and directing of *Westworld, Coma, The Great Train Robbery, Looker,* and the recently released *Runaway.*

The rapid growth of technology—and the decisions it necessarily forces on societies—has been a major theme in much of Crichton's work. He's been interested in the artistic potential of microcomputers since the start, and owns several himself, including an Apple, a Commodore 64, a Radio Shack Model 100, and several IBM PCs.

Crichton has used his micros primarily for word processing and game playing, but was especially intrigued by the possibilities that lay in adventure gaming, and disappointed that games weren't being more cleverly designed.

I simply didn't understand the mentality that informed them. It was not until I began programming myself that I realized it was a debugger's mentality. They could make you sit outside a door until you said exactly the right words. Sometimes you had to say, "I quit," and then it would let you through.

Well, that's life in the programming world. It's not life in any other world. It's not an accepted dramatic convention in any other arena of entertainment. It's something you learn to do when you're trying to make the computer work.

So in 1982, eager to explore this participatory art form, Crichton started to script his own adventure game. Since the only computer language he knew well was BASIC, he hired programmer Steve Warrady to help translate his story into graphics and text using Apple assembly language.

I wanted to make a game that tended to reflect my own prejudices. My prejudice is that I'm not a fantasist. I don't like magic spells to get me across the river and I don't like to meet trolls and dwarfs. I got tired of that when I was six.

So I wanted to have a more realistic world. In Amazon, *when you get to the river and find the boat that has a hole in it, there are three ways to patch it. And they're all things that would work with a real boat. You just use your head and say, "What would I do with the material available to me in the real world—this tangible world we all know about—that would work?"*

Another prejudice: *In* Amazon, *you can't solve your problems with violence. In general, as you go along, you'd better be more clever than violent.*

And another: *The mazes in this game are only there for punitive reasons. I loathe mazes. I think they're a programmer's trick. They make the game slower and longer without being a very complicated programming task and not very interesting. If you make a mistake in Amazon—and it generally has to be a bad mistake—you get dumped in a maze.*

Crichton discovered something surprising along the way: There wasn't much difference between writing an adventure game and scripting a movie.

Every consideration in making a movie is to try to see what the audience is thinking. Have I shown them this long enough? Did they get this point? Can they tell what this sound is?

In writing an adventure game, those considerations are merely formalized, since the audience will in fact be literally responding. So I have to think, "If they're outside this door, what will they think? Will they be afraid to go in? What would a person do in this situation?"

New Designer

Here's what I found out early on: You can't have extremely varied choices that don't seem to matter. I can go north, south, east, or west, and who cares? *You can only do that for a while, and then if you don't start to have an expectation of what will happen, you'll stop playing the game. You'd better get right going and you'd better start to have something happen.*

If I play a game for a half-hour and it doesn't make any sense to me, I'll just quit and never go back. Say I'm locked in this house and I don't know what the point of the house is and why I can't get out and there's no sort of hint to me about the mentality that would assist me in getting out—I don't know. I could say "Shazam!" or I could burn the house down or—give me a break. I just stop.

Crichton, a professional storyteller, took tremendous care with the plot, the actual story line of *Amazon. I think about a plot as being a story where you can imagine the consequences as you go. It's like the little guy who yells at the screen, "Look behind you, Hoppy!" You must know something the character doesn't. The audience has an expectation—if you go in this room, the bad guy will be there. That's plot.*

At a certain point in the process of designing *Amazon*—after all the material was generated, all the possible plot twists, and settings and characters were either accepted or rejected—Crichton started treating the game like a movie. He and his programmer and graphic designer collaborated like the creative and technical forces of a film crew collaborate.

The game took 18 months from start to finish, perhaps a bit longer than most videogames, but as Crichton says, they were all learning. *We're not a professional software company. We're just some people making a program.*

Trillium approached Crichton to acquire book rights about the time he was polishing *Amazon. They came to me and said they wanted to do a series of adventure games based on novels and I said, "Guess what? I just finished one." It was absolute coincidence.*

Amazon has its share of bad guys, but they're generally human, unlike the high-tech villains in many of his other creations. Technology, though, is not the enemy. Crichton thinks that he may have been misunderstood in the past.

Everyone remembers the scene in Westworld *where Yul Brynner is a robot that runs amok. But there is a very specific scene where people discuss whether or not to shut down the resort. I think the movie was as much about that decision as anything. They just didn't think it was really going to happen.*

I don't see technology as being out there, doing bad things to us people, like we're inside the circle of covered wagons and technology is out there firing arrows at us. We're making the technology and it is a manifestation of how we think. To the extent that we think egotistically and irrationally and paranoically and foolishly, then we have technology that will give us nuclear winters or cars that won't brake. But that's because people didn't design them right.

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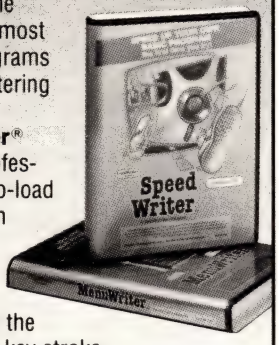

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Besides characters and stories from books and movies, other famous personalities and trends have been incorporated into entertainment software.

The recent awareness of breakdancing has spawned at least two computer games: *Break Street*, by Creative Software, and *Breakdance*, by Epyx. Both games feature breakdancers performing various steps, and allow you to choreograph your own dances or imitate routines already created.

Epyx has also released three other programs based on famous faces. In *Barbie*, you can do the same things that young girls have done with Barbie dolls for 25 years: shop for or design clothes, style and color Barbie's hair, and dress her up. *G. I. Joe*, taken from the familiar child's toy, lets you select a battle situation and outfit your soldier to fight. And everyone gets to try for revenge on Mr. Hart in *9 To 5 Typing*, a typing tutorial using characters from the movie *9 To 5*.

J.R. haters don't have to wait until Friday night to see their favorite villain. Datasoft's *Dallas Quest*, a text and graphics adventure, puts you in South Fork and pits you against the TV show's bad guys as you try to succeed in a dangerous task given to you by Sue Ellen. Datasoft has also recently released *Conan*, based on Arnold Schwartzenegger's musclebound hero, and *Bruce Lee*, based on the karate expert of film fame.

Commodore and Marvel Adventures, along with the programming talent of Scott Adams, have designed an adventure game based on the television show *The Hulk*. The player controls the intellect of both Bruce Banner and his alter ego, the big green guy, as he struggles to unlock the riddle of the Chief Examiner.

Cartoon characters continue to show up in games, too. Sierra On-Line, which brought you *BC's Quest For Tires*, has licensed some of Walt Disney's creations for use in educational software. *Donald Duck's Playground* helps develop money-handling skills, as well as shape, color, and letter-matching abilities. *Mickey's Space Adventure* promotes the development of mapping and problem-solving skills while teaching about the solar system. And *Winnie The Pooh In The Hundred Acre Wood* encourages good mapping and reading skills.

Spy vs. Spy, the cartoon strip series from the pages of *MAD* magazine, is now a computer game, published by First Star Software. In it, the White Spy and the Black Spy play tricks on each other and oppose each other in competitive, humorous, and dangerous situations.

A big name doesn't guarantee a superior game, but it may improve sales. And when a personality doesn't just endorse a product, but is actually involved in its design and production, you've probably got a better than average program—if the individual was working within his or her own area of expertise.

Filmmakers and play producers try to get "names" for their shows, not only because they'll draw bigger crowds, but because, generally, that person had to evidence some talent to become a name in the first place.

Will people buy software if a superstar was involved in its making? Does Michael Crichton think that his name will influence people to buy *Amazon*?

"I don't know. What do you think?" he says. "I don't think it matters. I think what's important is that it's a good game." ©

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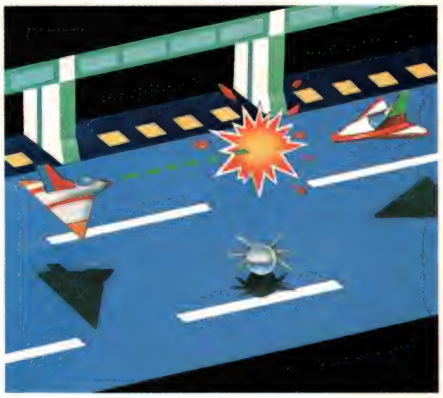

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BIRTH OF A COMPUTER GAME

Sharon Darling, Research Assistant

Five of the world's best computer game designers talk about how they create their games.

Chris Crawford, Jon Freeman, Bill Budge, Bruce Carver, and Dan Bunten—some of the most famous names in computer game design—don't consider themselves master programmers. It might be more accurate to call them artists who also know how to program a computer.

"I wouldn't characterize myself as a brilliant programmer; I would characterize myself as a competent programmer, and that's about all," says Crawford, the designer behind such critically acclaimed games as *Eastern Front* and *Excalibur.* "Great games don't spring from brilliant programming," he adds. "Brilliant programming can only take you a very short distance. The first real trick is at the design stage."

Budge, who created *Pinball Construction Set,* an innovative, seminal game, concurs. "It's important not to be just a programmer right now," he says, "and I think the most unique thing I do is in the area of designing, although I also think I'm lucky that I'm a good programmer, so I don't necessarily have to depend on other programmers."

Another vote for the importance of design comes from Bruce Carver, author of the games *Beach Head* and *Raid Over Moscow.* "A programmer has to be some kind of artist in addition to being just a raw programmer," he says. "If he can't sketch and draw pictures, he has to rely on an outsider to help him program the game if he wants it to look good.

"And the problem with that is that an artist just sees the picture in his mind, he doesn't really see things interacting from a programmer's point of view. So we feel that a good programmer has to be three or four different people at the same time if he wants to do this game and make it very cohesive."

While the basic idea for a game may come from anywhere—the name *Raid Over Moscow* sprang up on a trip from Las Vegas to Carver's home in Utah—from that point on, the process becomes very detailed and takes months to complete. "Regardless of how it [an idea] starts, a premise has to be developed," Carver says. "So what we [the design team at Access Software] do is sit down in a meeting, and we talk about this idea that we think has potential."

Moving from the talking stage to the completed game involves many steps, and the game may even be shelved at some point along the way because the original idea just didn't lend itself to a finished product.

"We're firm believers in the storyboard type of approach," says Bunten, whose software development firm, Ozark Softscape, turned out the hit games *M.U.L.E.* and *Seven Cities of Gold.* Using such a system means that "you've worked out

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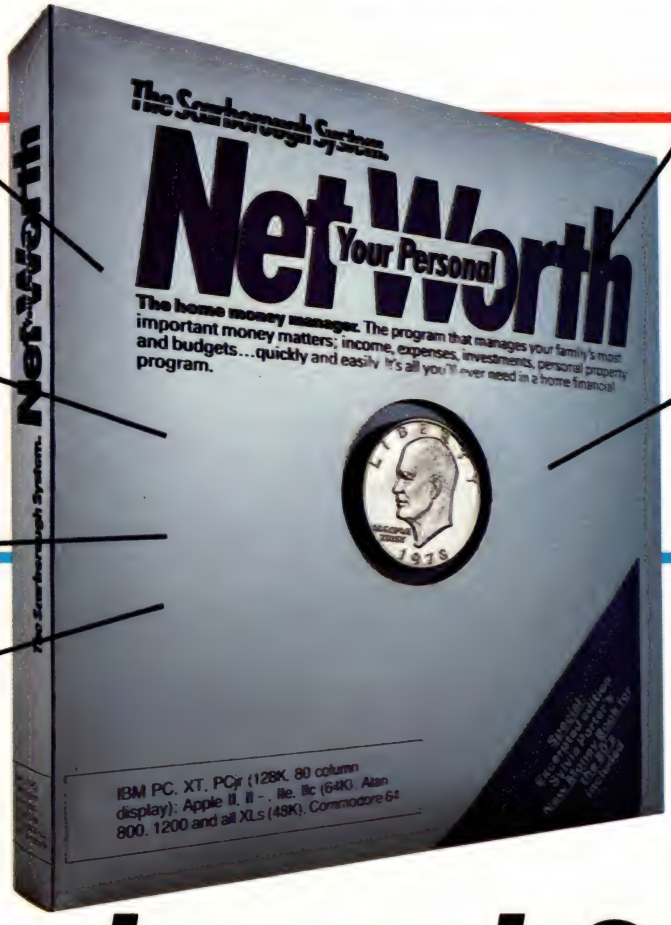
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at that point most of the key conceptual elements, and you work out what the driving motivation is that the player should experience when he's playing," Bunten says. "What's his goal—what is he after, what does he want to get out of this experience? That's one of the first things we want to get. Then we'll figure out, based on that, how the environment has to support the image."

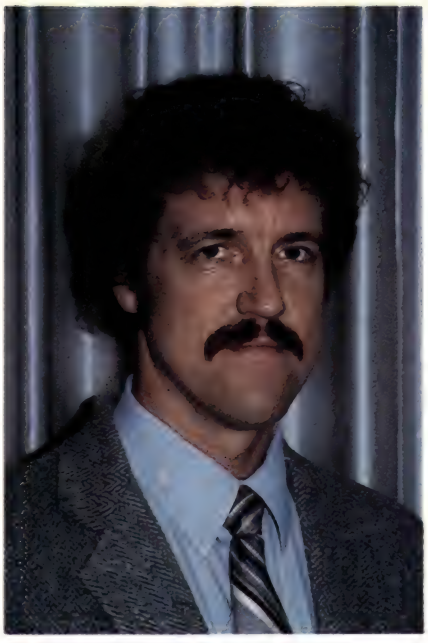
Carver looks for a sweaty-palm feeling. "There's a lot of thought given to what's going to be the most playable screen. You want to take that user to the point where his hands start getting sweaty, and he's always making decisions on what he's going to be firing at, or what he's going to do.

"If you just always have the same thing for him, he's going to get bored really quickly, so you make his mind work, you give him options. . . . We try to very subtly put those all through the game, so it's not really apparent, but it retains the interest for a long time."

Freeman, whose credits include *Archon, Archon II: Adept,* and *Murder on the Zinderneuf,* says he starts with an idea "that has become sufficiently clear and sufficiently compelling or attractive—whichever project is nagging me the most." From there, an outline is developed to chart the game's direction.

"We have a good idea where the game is going and what it will look like at the beginning," Freeman says of his software team, Freefall Associates. "But there's a lot of fine-tuning that can only be done after the game has started to take concrete form.

"The design is not something cast in stone that has to be followed to the letter—it's more of a guideline. Many people who start have only a vague idea where they're going. We do have a pretty good idea where we're going, but that doesn't mean we don't run into blockades. We kick out ideas and throw out the bad ones."



Bruce Carver

Also, some games contain hidden lessons. "Some of the games I've done have had goals of teaching people about nature or warfare—specifically, the goal of quantitative factors versus false factors," Crawford says. "The point of the game *Excalibur* is leadership. I didn't set out to do a King Arthur game—I set out to do a game about leadership. And once you've chosen your goal, you choose a topic that is a theme for expressing your goal."

With *Eastern Front,* he adds, the goal was "to teach people the difference between fire power and military effectiveness—it was something that was bothering me. A lot of Americans have this problem in thinking that the more weapons you have, the more powerful you are."

In *Seven Cities of Gold,* Ozark Softscape embodied three different ideas, Bunten says. "One was that the world was big and enormous, and these people were really brave to head off into the total unknown. Second, interaction with the natives was a subtle kind of communication; there was always a language barrier. Third," he adds, "there was a moral dilemma built in. Just because you're big enough to take what you want, does that make it right to take it?"

At first, players who field tested the game would take all the goods and gold they could from natives. But soon the testers "began to discover that they didn't feel real good about themselves, so they would get to a point where they would build rules for themselves, like 'Well, I won't kill them unless they kill me first.' "

Sometimes, the hidden messages can be as subtle as not using sexist terms, as in *Archon* and *Murder on the Zinderneuf.* "Our documentation is not sexist, not even vaguely," Freeman says. "There are both male and female characters on the board in *Archon,* and female characters are not weaker than the male characters as a group. In *Murder on the Zinderneuf,* there are an equal number of [male and female] suspects, and there is a mix of detectives. Anybody can get killed, and anybody could have done it.

"That's all secondary to the point of having fun," he adds. "But it's in there by design."

If a would-be game designer wants to get started in the field, there are basically two approaches to take, at least judging by these five aces: either try to come up with something that breaks the mold as far as computer games are concerned, or start out using what's been done before as a guide.

Budge found success by improving on what had come before. "The way I got started was by not trying to do anything original at all," he recalls. "I wanted to learn how to write

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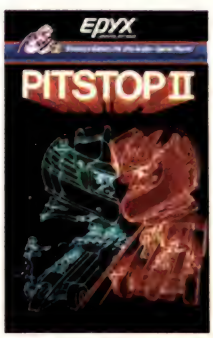

Dan Bunten

Bill Budge

Jon Freeman and Anne Westfall

videogames. I bought an Apple about five years ago and just went to arcades and copied the games that I saw." He adds that his main interest at the time was in creating "neat pictures and neat sounds."

A really good game, he says, would turn the player into a hacker. "You should provide environments where it's fun to put together things that are structured on a computer, but you don't have all the junk that you have when you're programming. You sort of restrict people to doing things that are like videogames, or pictures and sound, and take away all the busywork part."

Toward that end, a project he is working on now is a construction set to build construction sets. "That's a very difficult program to write, and I could never have written that before *Pinball*. After I did *Pinball*, it seems like there's some faint chance." He also adds that if he hadn't started out the way he did, "I wouldn't be qualified to take the next step."

The environment for that project, which he says will take several years to complete, "is the sort where you can just play and not worry about the consequences of every single mistake. You can mix and match, you don't have to write something totally new, you can take something from *Pac-Man* and take a piece from *Donkey Kong* and make it work."

Oddly, Budge doesn't like to play arcade and videogames very much. In fact, he says it was "sheer torture" to play pinball steadily for months while working on his construction set. "There are other people who are into games and are better at it than I am, so I had to figure out ways to get around the gaming, but I still wanted to create things that were like videogames," he says.

Bunten also thinks taking a lesson from what's been done by others is useful for new designers. "Typically, my first game was a knock-off of someone else's game, and it was an enhancement of things that I thought were needed. You've got to build some experience just with the medium and what is possible, before you can jump off into some new territory.

"As long as it doesn't violate any copyright, it's probably a good way to get started. Somebody said there's nothing new under the sun, and there probably isn't."

Carver feels beginning designers need to realize that the process is not all fun and games. "It's not something that's as glamorous as it might sound," he says. "There are times when I want to leave so bad—I tend to get really grouchy—but I know if we're going to get it finished in, say, five months, then I have to stay and get the work done."

He agrees that "if you use other people's stuff, you'll get into a mold and you can't really get out. I find I have to consciously work on changing the things I do, otherwise I'll tend to do them the way I did them before, and the game will tend to have the same feel that it had before."

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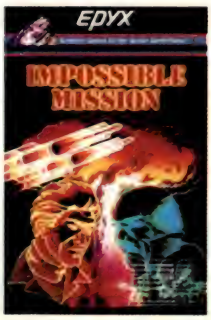

Crawford feels the most important consideration in game design is something he calls "artistic honesty." Far too many people, he adds, are writing programs that are imitations of other games. "They say 'Well, I'm going to do games!' Then they say, 'Well, what kind of games do I like right now? Well, I sure liked *Pac-Man*—let me do a variation on that.' And that is just the wrong way to do it.

"The right way to do it is to ask yourself what is an important interest around the world, and then try to capture that attraction," he asserts.

Freeman also feels that some game designers have fallen into a rut. "I think there are all sorts of subjects and lots of techniques and lots of approaches that are available, that haven't been done. I think, on the other hand, that many designers are in a rut—they define their universe too narrowly, in my opinion," he says.

While these five designers may differ in their opinions on how best to approach game writing, there is one point on which they all agree: Right now, it's tough for anyone, no matter how good, to get a game published in today's volatile software market.

Perhaps Crawford says it most gently. "I will point out the sad truth. We have pretty much passed the period where hobbyists could put together a game that would have commercial prospect. It's much more difficult to break in, much less stay in. Right now, in November 1984, I would discourage anyone. If you want to do a game, do it for fun, but don't try to do game designs to make any money. The odds are so much against the individual that I would hate to wish that heartbreak on anyone." ©

Chris Crawford

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"Acrobat" is a realistic, fast-moving arcade-style game. You must guide your alter ego on a perilous journey through mountains, jungles, and underground caves, while avoiding numerous obstacles by jumping, flipping, or sliding under them. You can select any of three different speeds to start off with, but the action will get faster and harder with each new level you reach. Acrobat will challenge your sense of timing as well as your reflexes. Versions for Atari, Commodore 64, and VIC.

The playing field of "Acrobat" is divided into two sections. The top of the screen contains your man, the obstacles, and the background scenery. The scoreboard is located at the bottom of the screen. It contains your current score, the high score so far, and at the far right, the number of men you have left. You begin the game standing in the middle of a mountain valley, ready for your journey.

At the beginning of each game, you can choose between three levels of difficulty by pressing the corresponding number. Level 1 is the easiest. Level 3 is almost impossible.

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After you have started the game, your man will begin to run. He runs forward automatically, and he cannot be stopped. You must maneuver past the various obstacles that come at you. You can push the joystick forward to jump, backward to slide, or press the joystick button to flip. If you manage to stay alive long enough, you will advance a level, and face new challenges. If you touch any of the obstacles, you will collapse in a heap and lose a man. Push the joystick in any direction to continue. You will receive a free man when you reach 2000 points, and at every 1000 points thereafter.

You receive points for everything you do. You get 20 points for a jump, 10 points for a slide, 10 points for a flip, and 2 points for every step you take forward. Your score is updated periodically throughout the game.

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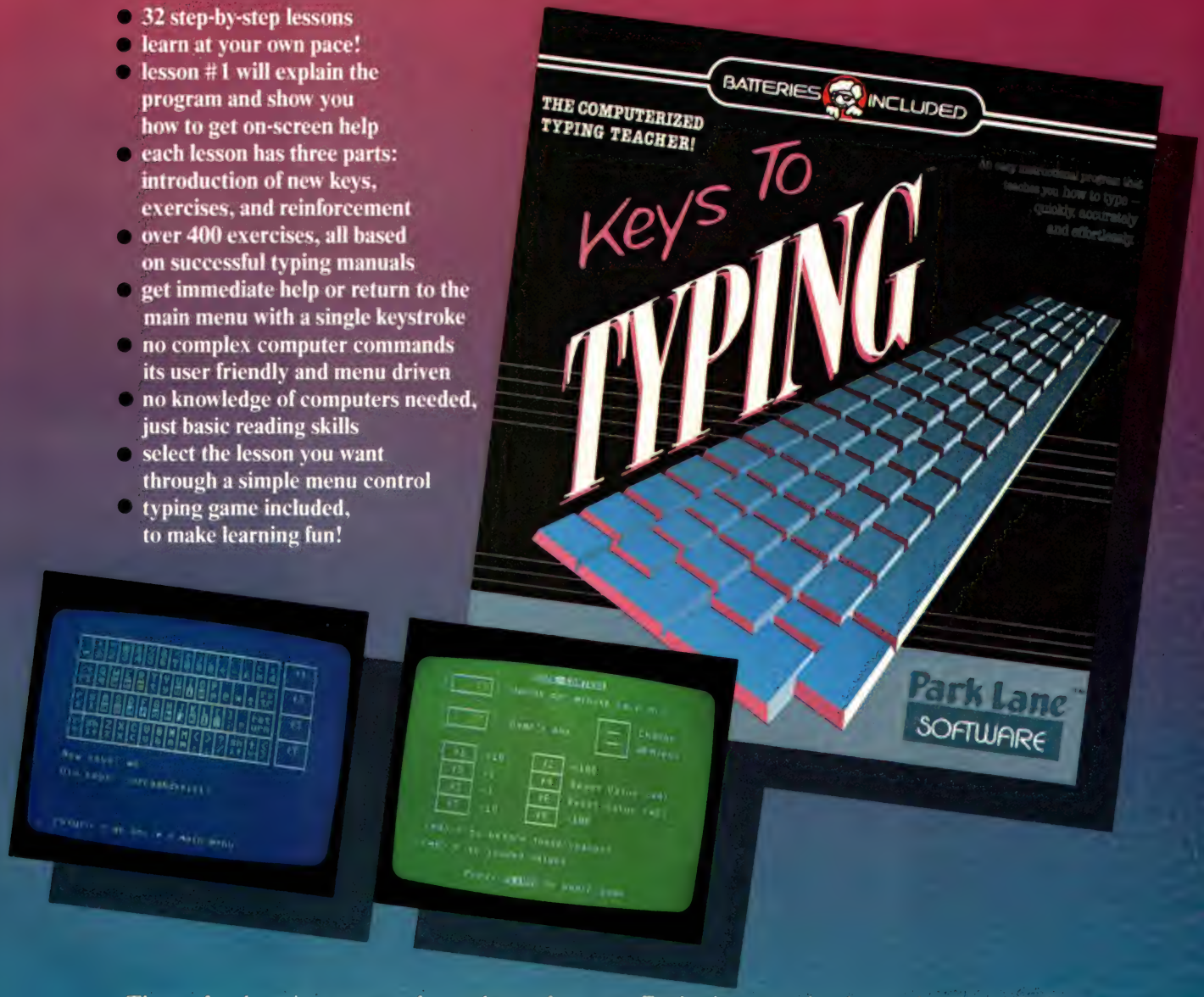

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Press START to restart the entire game at any time except during a pause.

Programming Techniques

Acrobat uses several special features of the Atari computers. High speed player/missile graphics and horizontal scrolling create an effective illusion of movement. Vertical blank interrupts, custom display modes, machine language routines, and numerous sound effects are also used to enhance the game.

The routine at line 30000 appeared in the article "Extending Player Missile Graphics" (COMPUTE!, October 1981). This short but extremely powerful routine changes the shape of a player at machine language speed. This helps create smooth animation with just one player. I've used this method throughout the program to animate the acrobat and change the shapes of the obstacles. The data for the different shapes of the acrobat are stored in RAM, and their locations are placed into the array PI(). The data for the numerous obstacles are likewise tucked away in safe RAM, and their locations are placed in the array OB().

The second machine language routine in the program starts at line 30700. This is a slightly modified version of one that appeared in *ANTIC* (June 1982). This routine moves the obstacles horizontally during the Vertical Blank Interrupt, which occurs 60 times per second. Once this routine is set up and called, it will operate continuously until told to stop.

Coarse horizontal scrolling occurs in the subroutine at line 90. Line 50 determines the address of screen memory, and stores it in the variable DL4. Then, in line 90, the value stored in DL4, PDL4, is increased and checked to see if it is too high. If it is, PDL4 is set equal to a much lower number. This causes a wraparound effect. Line 125 POKEs PDL4 into DL4, which causes the top half of the GRAPHICS 8 screen to scroll.

Be very careful typing in lines 27000 to 27070. This subroutine uses the Atari forced read mode to erase certain lines after they are not needed anymore. This increases the amount of memory available before going into GRAPHICS 8. If you have a full 40K–64K system, you can replace these lines with 27000 RETURN. If you need to type this section in, *be sure to save the program before running it.* If you forget to save, you will lose almost half of what you had typed in.

If you would rather not spend the time typing in Acrobat, I will make a copy (Atari version *only*) if you send me a blank tape or disk, a self-addressed, stamped mailer, and $3.

Peter Rizzuto
9 Idlebrook Lane
Aberdeen, NJ 07747

Program 1: Atari Acrobat

Refer to "COMPUTE!'s Guide For Typing In Programs" article before typing this program in.

```
JI 10  GOSUB 19000:GOSUB 20000:GOSUB
       25000:GOSUB 20100:GOSUB 27000
AG 11  D=USR(1536):GOSUB 21000:GOSUB
       21220:GOSUB AD:POKE XP,X:GOSUB
        19500:GOTO WT
OI 12  D=USR(ML,MANY,PI(9)):GOSUB MO:
       RETURN
AC 20  D=USR(ML,OB2,OB(QW1)):QW1=QW1+
       01:IF QW1>MAXQ THEN QW1=MINQ
EH 25  RETURN
AN 30  D=USR(ML,OB1,OB(QW)):QW=QW-01:
       IF QW<MINQ THEN QW=MAXQ
EE 31  RETURN
CO 40  POKE C6,01:POKE C7,9:? SCORE:I
       F SCORE>ZIP THEN GOSUB 23500:R
       ETURN
EF 41  RETURN
OC 50  DL=PEEK(560)+256*PEEK(561):DL4
       =DL+Z:PDL4=PEEK(DL4):POKE DL+1
       31,13:POKE DL+132,J:POKE DC,U:
       POKE 708,44
LA 55  GOSUB SY:RETURN
GE 90  ST=STICK(0):PDL4=PDL4+J:IF PDL
       4>120 THEN PDL4=81:SC=SC+01
DL 100  IF LEVEL<200 THEN IF PEEK(X1P
       )<25 THEN POKE X1P,220:GOSUB
       B2
DP 110  IF LEVEL>100 THEN IF PEEK(X1P
       )>220 THEN POKE X1P,25:GOSUB
       B2
CO 120  IF PEEK(X2P)<30 THEN POKE X2P
       ,255:GOSUB 30
OF 125  POKE DL4,PDL4:RETURN
DC 200  GOSUB MO:SOUND J,150-Y,8,Z:GO
       SUB 12:SCORE=SCORE+B2:YF=Y:FO
       R Q=01 TO K:YF=YF-J:F=5:GOSUB
        JUM:NEXT Q
DJ 205  SOUND J,150-YF,8,Z:FOR Q=01 T
       O K:YF=YF-J:F=6:GOSUB JUM:NEX
       T Q:SOUND J,150-YF,8,Z:GOSUB
       40:FOR Q=01 TO 6
JN 215  YF=YF+J:F=7:GOSUB JUM:NEXT Q:
       SOUND J,150-YF,8,Z:F=K:SOUND
       J,0,0,0:GOSUB JUM
GE 240  F=Z:IF PEEK(CO) THEN 10000
AK 245  D=USR(ML,MANY,PI(F)):POKE RES
       ,0:SOUND 1,0,0,0:RETURN
FE 250  D=USR(ML,MAN+YF,PI(F)):GOSUB
       MO:SOUND 01,170-YF,E,J:RETURN
EN 300  GOSUB MO:GOSUB U:SOUND J,170-
       Y,8,Z:SCORE=SCORE+E:YF=Y
GI 305  FOR A=01 TO J:FOR F=11 TO 14:
       YF=YF-J:GOSUB JUM:NEXT F:NEXT
        A:SOUND J,170-YF,8,Z:GOSUB 40
EE 310  FOR A=01 TO J:FOR F=11 TO 14:
       YF=YF+J:GOSUB JUM:NEXT F:NEXT
        A:SOUND J,0,0,0:GOTO 240
GI 315  GOTO 240
PG 2000  GOSUB MO:D=USR(ML,MANY,PI(F)
       ):IF PEEK(STA)=6 THEN 11100
PL 2005  IF PEEK(KEY)=33 THEN GOSUB 1
       30000
JF 2010  SOUND 01,231+F,E,E:SOUND 01,
       0,0,0
PP 2015  IF PEEK(CO) THEN GOSUB 10000
BC 2020  IF ST=13 THEN GOSUB 8000
```

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Notes For Commodore Versions

The Commodore versions of "Acrobat" have the same goal as the Atari version; you must slide, flip, and jump to avoid anything that gets in your way.

Both the VIC-20 and Commodore 64 versions use the keyboard rather than the joystick. This permits a more sensitive response to the player. If you don't like the keys chosen, the 64 version allows you to make changes at the start of the program. This feature is not present in the VIC version, but changes can be made by altering the letters J, S, and F in lines 35–45 of Program 4.

The VIC and 64 versions are written primarily in BASIC, with a machine language subroutine used for scrolling and placement of the obstacles.

The 64 version (Program 2) contains an interrupt-driven subroutine to scroll the playfield smoothly. A single sprite is used for the acrobat. Its movement is simulated by continually changing the sprite data pointer (using the FOR–NEXT loop beginning at line 21) to point to each of the acrobat's different positions.

The Night Runner

An interesting addition to the 64 version is a night mode. Here your acrobat runs through the darkness with only a flashlight to light his path. You may have seen this effect in arcade racing games. This was done by filling the color RAM with black (to turn everything invisible) then placing a white sprite in front of the acrobat. To insure that screen objects would be visible in the light, the sprite-to-background display priority register was set to give the background priority over the spotlight sprite.

The scoring of the 64 version is fairly straightforward. Each time the acrobat jumps over or slides under something, you are given 2 points. A flip, because it is much harder to control, is worth 5 points. Later in the game, a chicken will start flying on the screen. Every time you can avoid hitting the chicken, you are given an additional 10 points.

An extra acrobat is awarded for every 100 points; a quick change of border color will indicate that an extra man was earned. The score will be shown only when you lose an acrobat.

VIC Autoload

The VIC version of Acrobat requires no memory expansion. The program is written in two parts (Programs 3 and 4) and chained to make efficient use of the small amount of memory present. Program 3 will automatically load and run Program 4 from disk. To use the programs with tape, change the 8 to a 1 in line 15 of Program 3, and be sure to save Program 4 immediately following Program 3 on the tape. For either disk or tape, you must save Program 4 with the name AC for the autoload feature to work properly. To avoid an OUT OF MEMORY error, do not add any extra spaces to the program lines when typing Programs 3 and 4.

In this version, custom characters were used in place of sprites. Because of this, smooth horizontal scrolling was not possible.

The VIC rules are slightly different from the 64 version. To make the game more challenging, the acrobat now moves forward. There will be a slight flash of the border color to warn that the acrobat will soon move.

Scoring is as follows: For obstacles you jump over or slide under, you are given 2 points. Flips are worth 8 points, and for each block you move forward, you are given an additional bonus of 10 points.

```
DC 2025  IF ST=14 THEN GOSUB 200
EL 2030  IF STPIG(0)=0 THEN GOSUB 300
LD 2035  IF SC>7 THEN MAXQ=MAXQ+01:MI
         NQ=MINQ+01:SC=0:IF MAXQ>LIMI
         T THEN 24000
BD 2040  F=F+01:IF F>Z THEN F=01
KK 2045  SCORE=SCORE+J:GOTO 2000
EA 8000  SCORE=SCORE+E:D=USR(ML,MANY,
         PI(16)):GOSUB MO
CO 8010  FOR T=01 TO 7:D=USR(ML,MANY,
         PI(17)):GOSUB MO:NEXT T:GOSU
         B 40:D=USR(ML,MANY,PI(16)):F
         =01:RETURN
EN 9000  SOUND 01,INT(RND(0)*40),E,J:
         RETURN
OP 9100  POKE X1P,0:POKE X2P,30:POKE
         G8,0:POKE G9,0:POKE 53249,0:
         POKE 53251,30:POKE 705,BACKC
         :POKE 707,BACKC:RETURN
CH 9200  POKE 705,U:POKE 707,136:POKE
          G8,01:POKE G9,01:RETURN
GC 9500  RETURN :READ A,I,R,L:IF A=-0
         1 THEN GOSUB 14000:RETURN
AN 9510  SOUND 0,A,E,6:SOUND 01,I,E,6
         :SOUND J,R,E,Z:FOR I=01 TO L
         :NEXT I:GOTO 9500
AP 10000 GOSUB 14000:D=USR(ML,MANY,P
         I(E)):LI=LI-01:GOSUB SY:D=U
         SR(ML,MANY,EX(01))
KB 10005 FOR I=01 TO K:D=USR(ML,MANY
         ,EX(I)):FOR A=01 TO 8:NEXT
         A:NEXT I:FOR I=01 TO 65:NEX
         T I
JO 10010 D=USR(ML,MANY,EX(Z)):SOUND
```

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```
      01,255,8,8:GOSUB SY:POKE CC
      ,K:POKE C7,36:POKE C6,01:?
      LI:SOUND 01,0,0,0:IF LI=0 T
      HEN 11000
IM 10012 FOR I=01 TO 50:NEXT I:RESTO
      RE 31700:GOSUB 9500
HJ 10015 IF PEEK(STA)=6 THEN 11100
GJ 10020 IF STICK(0)=15 THEN 10015
OA 10025 POKE RES,0:GOSUB GO:POKE CC
      ,K:ST=15:RETURN
AD 11000 POKE C6,K:POKE C7,K:? "*****
      *********GAME OVER!*********
      *****{UP}":POKE C6,01
IK 11002 FOR I=01 TO 50:NEXT I:RESTO
      RE 31500:GOSUB 9500
IK 11005 IF STRIG(0)=0 OR PEEK(STA)=
      6 THEN SOUND 01,0,0,0:POKE
      RES,0:GOTO 11100
KG 11010 GOSUB 9000:GOTO 11005
OL 11100 QW=01:QW1=01:F=E:MINQ=01:MA
      XQ=J:LI=K:SC=0:X=120:LIMIT=
      6:BACKC=96:LEV=01:SPED=197
JK 11105 POKE BC,BACKC:POKE PC,BACKC
      :GOSUB SY:POKE XP,0
IB 11110 POKE DC,BACKC:POKE DL+131,1
      5:GOSUB SY:POKE XP,0:POKE 1
      552,198:POKE 1554,197:POKE
      1565,198:POKE 1567,197
HC 11120 POKE DL4,80:GOSUB 21220:GOS
      UB 21038:IF SCORE>HI THEN H
      I=SCORE
LN 11125 POKE C6,01:POKE C7,26:? HI:
      SCORE=0:POKE DC,U:POKE DL+1
      31,13:IF LEVEL=0 THEN 11130
KL 11128 RESTORE 31000+LEVEL:COLOR 0
      :GOSUB 15000:RESTORE 31000:
      COLOR 01:GOSUB 15000
IH 11130 LEVEL=0:POKE XP,X:GOSUB AD:
      GOSUB 19500
BH 12000 IF STICK(0)<>15 OR PEEK(STA
      )=6 THEN 12030
LJ 12005 IF SCORE>0 THEN 12025
IL 12010 IF PEEK(KEY)=31 THEN POKE C
      6,K:POKE C7,31:? "1{UP}":TY
      P=01:POKE 1554,197:SPED=197
FL 12015 IF PEEK(KEY)=30 THEN POKE C
      6,K:POKE C7,31:? "2{UP}":TY
      P=J:POKE 1554,198:SPED=197
FP 12020 IF PEEK(KEY)=26 THEN POKE C
      6,K:POKE C7,31:? "3{UP}":TY
      P=K:POKE 1554,198:SPED=198
CP 12025 POKE RES,0:GOSUB 9000:GOTO
      WT
GG 12030 SOUND 01,0,0,0:POKE KEY,255
      :GOSUB 19505:RESTORE 31800:
      GOSUB 9500:GOSUB GO:POKE CC
      ,K:GOSUB 300:GOTO 2040
KF 13000 POKE KEY,255:D=USR(ML,MANY,
      PI(E)):GOSUB 14000:POKE G8,
      0:POKE G9,0
IN 13005 IF PEEK(KEY)<>190 AND STRIG
      (0)=1 THEN 13005
OG 13010 POKE RES,0:POKE KEY,255:POK
      E G8,01:POKE G9,01:RETURN
AJ 14000 SOUND 0,0,0,0:SOUND 01,0,0,
      0:SOUND J,0,0,0:SOUND K,0,0
      ,0:RETURN
FB 15000 READ XC,YC:PLOT XC,YC
IC 15010 READ XC,YC:IF XC=-01 THEN G
      OSUB 14000:RETURN
OO 15015 IF XC=-9 THEN 15000
PP 15020 DRAWTO XC,YC:IF XC>255 THEN
       XC=XC-255:SOUND 0,XC,E,J:G
      OTO 15010
AJ 15025 SOUND 0,XC,10,J:GOTO 15010
PL 16000 POKE XP,0:POKE 53249,0:POKE
       53250,0:POKE 53251,0
MC 16005 POKE 559,62:POKE PC,BACKC:P
      OKE DC,BACKC:POKE BC,BACKC:
      POKE 752,01:COLOR 01:RETURN
EE 16010 A=PEEK(16):IF A=128 THEN RE
      TURN
IK 16015 POKE 16,A-128:POKE 53774,A-
      128:RETURN
HC 17000 ? "{CLEAR}":IF LEV>9 THEN P
      OKE C6,J:POKE C7,9:? "You a
      re too good for me!":POKE D
      C,U:LEVEL=200:GOTO 11000
NI 17001 POSITION 01,01:? "{Q}{35 R}
      {E}":POSITION 01,J:? "!
      {6 SPACES}Now advancing to
      Level ";LEV;
PJ 17002 ? "{5 SPACES}!"
PA 17005 POSITION 01,K:? "{Z}{35 R}
      {C}":POKE C6,01:POKE C7,01:
      RETURN
KO 17500 A=100*LI/5:FOR I=01 TO 5:SC
      ORE=SCORE+A:POKE C6,01:POKE
       C7,9:? SCORE;:FOR R=01 TO
      20:SOUND 0,40-R*J,E,8
PN 17505 NEXT R:NEXT I:POKE C6,01:RE
      TURN
IB 19000 GRAPHICS 0:GOSUB 16010:POKE
       752,1:DL=PEEK(560)+PEEK(56
      1)*256:DL=DL+4:POKE 709,96:
      POKE 710,96:POKE 712,96
JA 19005 POKE DL+16,6:POKE DL+17,6:P
      OKE DL+28,65:POKE DL+29,PEE
      K(560):POKE DL+30,PEEK(561)
      :? "{CLEAR}"
BE 19011 POSITION 11,20:? "ONE MOMEN
      T PLEASE..."
BN 19015 POSITION 4,7:? "{Q}{2 R}
      {E} {Q}{2 R} {Q}{2 R}{E}
      {Q}{2 R}{E} {Q}{R}{E}  {Q}
      {2 R}{E} {R}{W}{R}":POSITIO
      N 4,8:? "!  ! !{3 SPACES}!
       ! !  ! ! !  !  !"
AG 19020 POSITION 4,9:? "{A}{2 R}
      {D} !{3 SPACES}{A}{R}{W}
      {C} !  ! {A}{R}{X}{E} {A}
      {2 R}{D}  !":POSITION 4,10:
      ? "!  ! !{3 SPACES}! {Z}
      {E} !  ! !  ! !  !  !"
AN 19025 POSITION 4,11:? "{X}  {X}
      {Z}{2 R} {X}  {X} {Z}{2 R}
      {C} {Z}{2 R}{C} {X}  {X}
      {X}":POKE 709,10:RETURN
EO 19500 POKE C6,3:POKE C7,8:? "Sele
      ct Difficulty ---> 1{UP}":T
      YP=1:RETURN
EF 19505 POKE C6,3:POKE C7,8:? "
      {24 SPACES}{UP}":RETURN
KK 20000 X=120:Y=141:F=10:QW=1:QW1=Q
      W:LI=3:HI=0:SCORE=HI:SC=HI:
      ML=1600:DIM PI(18),OB(17),E
      X(4):C6=656:C7=657:Z=4
AH 20005 XP=53248:X1P=206:X2P=207:MO
      =90:SY=9100:GO=9200:O=0:O1=
      1:PC=710:BC=712:DC=709:CO=5
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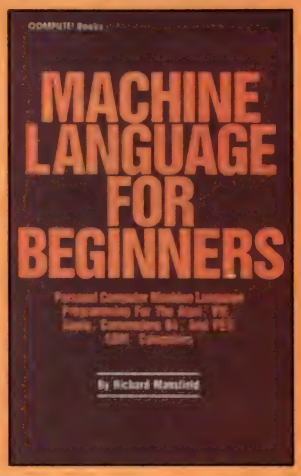

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```
        3260:J=2:G8=208:G9=209
PF 20010 STA=53279:CC=53278:RES=77:K
        EY=764:B2=20:WT=12000:AD=50
        :JUM=250:SPED=197:LEV=1:ZIP
        =2000:K=3:E=10:U=12
PM 20015 FOR A=1600 TO 1624:READ I:P
        OKE A,I:NEXT A:FOR A=260 TO
         419:READ I:POKE A,I:NEXT A
IF 20020 FOR A=1650 TO 1777:READ I:P
        OKE A,I:NEXT A:FOR A=01 TO
        18:READ I:PI(A)=I:NEXT A
AE 20025 A=PEEK(106)-40:POKE 54279,A
        :P=256*A:POKE 559,62:POKE 6
        23,01:POKE 53277,3:POKE XP,
        0:POKE 704,30
EE 20030 MAN=P+1024:MANY=MAN+Y:OB1=P
        +1280+141:OB2=P+1792+141:FO
        R I=MAN TO P+1536:POKE I,0:
        NEXT I
KK 20035 FOR I=P+1792 TO P+2048:POKE
         I,0:NEXT I:RETURN
NJ 20100 FOR A=P TO P+191:READ I:POK
        E A,I:NEXT A
CC 20105 C=01:FOR A=P TO P+159 STEP
        16:OB(C)=A:C=C+01:NEXT A:OB
        (11)=OB(8):OB(U)=OB(7)
EM 20110 FOR I=P+400 TO P+463:READ A
        :POKE I,A:NEXT I:C=01:FOR I
        =P+400 TO P+463 STEP 16:EX(
        C)=I:C=C+01:NEXT I
FI 20115 FOR I=P+200 TO P+247:READ A
        :POKE I,A:NEXT I:OB(13)=P+2
        32:OB(14)=OB(01):OB(15)=P+2
        16:OB(16)=P+200:OB(17)=OB(0
        1)
PI 20120 RESTORE 30700:FOR I=1536 TO
         1576:READ A:POKE I,A:NEXT
        I:POKE G8,0:POKE G9,0:POKE
        X1P,0:POKE X2P,B2:RETURN
MI 21000 GRAPHICS 8:GOSUB 16010:LEVE
        L=0:BACKC=96:GOSUB 16000:PO
        KE DC,U
HA 21005 MINQ=01:MAXQ=J:SC=0:LIMIT=6
        :POKE 1552,198:RESTORE 3100
        0:GOSUB 15000
CA 21010 FOR I=01 TO 319 STEP J:PLOT
         I,124:DRAWTO I,125:NEXT I:
        FOR I=J TO 318 STEP J:PLOT
        I,132:DRAWTO I,149:NEXT I
CP 21015 POKE DC,BACKC
KG 21038 ? "{CLEAR}":POSITION 01,01:
        ? "{Q}{31 R}{W}{3 R}{E}":PO
        SITION 01,J:? "¦SCORE:0";
GB 21040 ? "{7 SPACES}HI SCORE:0
        {7 SPACES}¦ 3 ¦":POSITION 0
        1,Z:? "{Z}{31 R}{X}{3 R}
        {C}":RETURN
LK 21220 D=USR(ML,OB1,OB(QW)):D=USR(
        ML,MANY,PI(F)):D=USR(ML,OB2
        ,OB(QW)):RETURN
KC 22000 BACKC=196:GOSUB 16000:GOSUB
         SY:GOSUB 17000:POKE DC,U:C
        OLOR 0:RESTORE 31000:GOSUB
        15000:COLOR 01
LO 22010 RESTORE 31100:GOSUB 15000
GE 22020 MINQ=7:MAXQ=8:QW=MINQ:QW1=Q
        W:SC=0:LIMIT=U:F=E:POKE 155
        2,198:POKE 1567,SPED:IF LEV
        =5 THEN LIMIT=E
JG 22030 POKE DC,BACKC:GOSUB 21038:G
        OSUB 21220
AK 22035 POKE C6,01:POKE C7,9:? SCOR
        E;:POKE C7,26:? HI;:POKE C7
        ,36:? LI
PL 22040 POKE DL4,80:D=USR(ML,MANY,P
        I(E)):GOSUB SY:POKE XP,120:
        POKE CC,K:POKE DC,U:GOSUB A
        D:GOSUB 17500:GOTO WT
FD 22100 BACKC=0:GOSUB 16000:GOSUB S
        Y:GOSUB 17000:POKE DC,U:COL
        OR 0:RESTORE 31100:GOSUB 15
        000:COLOR 01
MA 22110 RESTORE 31200:GOSUB 15000
MK 22120 MINQ=13:MAXQ=14:QW=MINQ:QW1
        =QW:SC=0:LIMIT=17:F=10:POKE
         1552,230:IF SPED=198 OR TY
        P=2 THEN POKE 1554,230
CM 22125 GOTO 22030
BE 23500 POKE PC,14:POKE BC,14:LI=LI
        +01:ZIP=ZIP+1000:POKE C6,01
        :POKE C7,36:? LI;"{UP}":POK
        E PC,BACKC:POKE BC,BACKC:RE
        TURN
IO 24000 LEV=LEV+01:LEVEL=LEVEL+100:
        IF LEVEL>200 THEN POKE DL+1
        31,15:GOTO 24500
BK 24010 POKE DL+131,15:GOTO 21900+L
        EVEL
DF 24500 BACKC=96:GOSUB 16000:GOSUB
        SY:GOSUB 17000:POKE DC,U
LB 24505 RESTORE 31000+LEVEL-100:COL
        OR 0:GOSUB 15000:RESTORE 31
        000:COLOR 01:GOSUB 15000:SP
        ED=198
MM 24510 LEVEL=0:BACKC=96:POKE 1552,
        198:POKE 1554,198:MINQ=01:M
        AXQ=J:QW=MINQ:QW1=QW:SC=0:L
        IMIT=Z:F=E:GOTO 22030
PC 25000 FOR I=30 TO 108 STEP J:POKE
         XP,I:D=USR(ML,MANY,PI(F)):
        F=F+01:IF F>Z THEN F=01
JB 25005 NEXT I:D=USR(ML,MANY,PI(9))
        :FOR A=01 TO J:FOR F=11 TO
        14:Y=Y-J:I=I+J:POKE XP,I
PJ 25015 D=USR(ML,MAN+Y,PI(F)):NEXT
        F:NEXT A:FOR A=01 TO J:FOR
        F=11 TO 14:Y=Y+J:I=I+J
IC 25020 POKE XP,I:D=USR(ML,MAN+Y,PI
        (F)):NEXT F:NEXT A:F=01
KN 25025 FOR I=I+J TO 220 STEP J:POK
        E 53248,I:D=USR(ML,MANY,PI(
        F)):F=F+01:IF F>Z THEN F=01
JO 25030 NEXT I:F=E:RETURN
HD 27000 GRAPHICS 0:POKE 752,01:POKE
         710,96:POKE 712,96:POKE 70
        9,96:POKE 842,13:GOSUB 16010
PI 27005 ? "{CLEAR}":POSITION J,6:FO
        R I=30000 TO 30010:? I:NEXT
         I:? "CONT":POSITION 0,0:ST
        OP
JC 27010 ? "{CLEAR}":POSITION J,6:FO
        R I=30080 TO 30098 STEP J:?
         I:NEXT I:? "CONT":POSITION
         0,0:STOP
LF 27015 ? "{CLEAR}":POSITION J,6:FO
        R I=25000 TO 25030 STEP 5:?
         I:NEXT I:FOR I=19000 TO 19
        025 STEP 5:? I:NEXT I:? "CO
        NT"
LK 27020 POSITION 0,0:STOP
```

```
JO 27025 ? "{CLEAR}":POSITION J,6:FO
         R I=20000 TO 20035 STEP 5:?
          I:NEXT I:FOR I=20100 TO 20
         120 STEP 5:? I:NEXT I:? "CO
         NT"
LL 27030 POSITION 0,0:STOP
PE 27035 ? "{CLEAR}":POSITION J,6:FO
         R I=27000 TO 27035 STEP 5:?
          I:NEXT I:? "30700":? "3070
         2":? "GOTO 27070":POSITION
         0,0:STOP
HG 27070 POKE 842,12:RETURN
DM 30000 DATA 104,104,133,204,104,13
         3,203,104,133,209,104,133,2
         08,160,0,177,208,145,203,20
         0,192,16,208,247,96
GN 30001 DATA 12,12,8,56,90,156,24,3
         0,18,36,72,132,128,0,0,0,12
         ,12,8,56,88,94,88,24,20,18,
         226,130,3,0,0,0
ML 30002 DATA 12,12,8,24,24,24,24,24
         ,216,56,20,4,4,4,6,0,12,12,
         8,24,56,56,60,56,30,18,20,1
         6,16,16,24,0
IM 30003 DATA 0,0,24,24,18,52,56,50,
         53,56,48,32,64,128,0,0,0,0,
         12,12,8,24,60,91,24,24,158,
         113,0,0,0,0
LP 30004 DATA 0,0,12,12,8,24,26,28,1
         52,88,56,28,2,1,0,0,0,0,12,
         12,8,24,26,28,24,24,120,12,
         4,4,4,0
HD 30005 DATA 0,0,0,0,0,0,0,0,0,0,0,0,
         0,0,0,0,0,12,12,8,24,24,24,
         24,24,24,8,8,8,8,8,12,0
BC 30006 DATA 0,0,0,192,200,132,204,
         248,112,0,0,0,0,0,0,0,0,0,0
         ,24,4,2,102,108,16,0,0,0,0,
         0,0,0
PK 30007 DATA 0,0,0,14,31,51,33,19,1
         9,0,0,0,0,0,0,0,0,0,0,0,8,54,
         102,64,32,24,0,0,0,0,0,0,0
FJ 30008 DATA 48,48,16,28,26,122,26,
         24,40,72,71,65,192,0,0,0,0,
         0,96,96,64,100,56,48,48,58,
         29,24,15,0,0,0
GD 30009 DATA 0,0,0,0,0,0,0,0,0,0,0,19
         2,208,144,254,125,0,48,48,1
         6,24,28,28,60,28,120,72,40,
         8,8,8,24,0
JH 30010 DATA 260,276,292,308,324,34
         0,356,372,388,404,1650,1666
         ,1682,1698,1714,1730,1746,1
         762
HN 30080 DATA 0,0,0,0,0,0,0,0,0,0,0,0,
         8,28,62,127,0,0,0,0,0,0,0,0
         ,0,0,8,8,8,8,8,8,0
PF 30082 DATA 0,0,0,0,0,0,0,0,32,64,25
         5,64,32,0,0,0,0,0,0,0,0,0,0
         ,0,8,8,8,8,8,8,8,8,0
BH 30084 DATA 0,0,0,0,0,32,64,255,64,3
         2,0,0,0,0,0,0,0,0,0,0,0,0,0
         ,0,255,255,255,255,255,255,
         255,255,0
DM 30086 DATA 0,0,0,0,0,0,0,64,255,64,
         0,0,0,0,0,0,0,0,0,0,0,0,0,4
         8,88,60,4,8,16,34,37,25,0
KN 30088 DATA 0,0,0,0,0,96,109,255,28,
         12,6,0,0,0,0,0,0,0,0,0,0,48,1
         12,248,236,70,3,1,0,0,0,0,0
         ,0
FM 30090 DATA 0,0,0,0,0,0,0,0,0,0,0,0,
         30,247,255,66,0,0,0,0,0,0,24,
         60,126,219,126,0,0,0,0,0,0,0,
         0
FO 30092 DATA 12,12,24,24,24,24,24,2
         4,24,24,8,44,8,16,0,0,0,0,1
         2,12,8,24,24,24,24,24,24,8,
         4,4,56,0
FD 30094 DATA 0,0,0,0,12,31,27,27,24
         ,24,24,8,4,4,56,0,0,0,0,0,0
         ,0,0,4,14,11,9,9,11,11,59,0
MN 30096 DATA 0,0,0,0,0,0,0,0,0,0,0,25
         5,255,126,126,36,0,0,0,0,0,
         0,0,36,126,219,129,0,0,0,0,
         0,0
OE 30098 DATA 0,0,0,0,0,0,0,0,0,28,8,8
         ,28,28,28,28,0
MB 30700 DATA 104,160,10,162,6,169,7
         ,76,92,228,169,0,197,208,24
         0,9,198,206,197,206,166,206
         ,142,3,208
DM 30702 DATA 197,209,240,9,198,207,
         197,207,166,207,142,1,208,7
         6,98,228
ME 31000 DATA 1,93,56,55,62,55,100,9
         3,134,67,170,93,210,59,245,
         80,280,67,319,93,-1,-1
IO 31100 DATA 1,50,4,52,8,53,14,53,1
         9,57,23,58,29,57,39,60,45,6
         0,45,93,65,93,65,60,71,60,8
         1,57,87,58,91,57,96
AC 31102 DATA 53,104,53,108,52,111,5
         0,119,40,125,37,130,30,133,
         25,132,18,131,13,131,7,128,
         3,124,1,-9,-9
IG 31104 DATA 45,60,47,61,49,63,52,6
         2,56,63,58,61,60,59,63,61,6
         5,60,-9,-9
MC 31106 DATA 115,45,120,48,125,49,1
         34,49,140,54,145,56,155,56,
         155,93
AC 31108 DATA 175,93,175,56,185,56,1
         90,54,196,49,206,49,211,48,
         220,45,223,40,227,35,226,34
         ,-9,-9
OE 31110 DATA 155,56,159,57,165,56,1
         70,57,175,56,-9,-9
GC 31112 DATA 220,45,225,50,234,51,2
         40,50,250,54,253,54,253,93,
         273,93,273,54,280,52
CJ 31114 DATA 286,51,294,52,300,54,3
         07,53,310,51,319,48,-9,-9
EF 31116 DATA 319,48,315,46,312,44,3
         10,40,308,36,305,35,300,28,
         298,24,299,20,300,17,302,12
         ,303,6,305,2,308,1,-9,-9
NF 31118 DATA 253,54,259,55,266,54,2
         70,55,274,54,-1,-1
KG 31200 DATA 1,1,10,10,30,10,38,18,
         43,30,50,54,60,65,65,52,70,
         72,72,75,74,80,85,80,90,72,
         94,66,123,66,123,55,140,40
IO 31202 DATA 135,24,145,15,160,24,1
         80,12,170,40,191,82,200,62,
         206,70,213,60,200,40,207,35
         ,213,43,230,24,240,50
OK 31204 DATA 256,50,260,55,273,30,2
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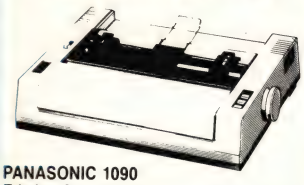

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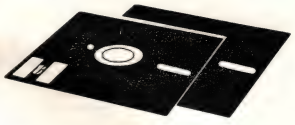

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```
        80,44,275,60,290,50,295,55,
        300,20,319,1,-1,-1
IG 31500 DATA 204,0,0,147,217,0,0,18
        ,204,0,0,91,173,0,0,95,182,
        0,0,90,204,0,0,70
AJ 31502 DATA 217,144,0,25,204,136,1
        02,140,-1,0,0,0
IA 31700 DATA 102,0,0,40,114,0,0,40,
        128,0,0,40,136,0,0,40,0,0,0
        ,40,162,108,0,40,153,102,76
        ,80,-1,0,0,0
EL 31800 DATA 162,121,96,70,121,96,8
        1,35,162,121,96,70,121,96,8
        1,35,96,81,60,70,-1,0,0,0
```

Program 2: Commodore 64 Acrobat

Refer to "COMPUTE!'s Guide For Typing In Programs" article before typing this program in.

```
1 POKE55,0:POKE51,0:POKE56,60:POKE52,60:C
  LR:POKE828,0                          :rem 155
3 L=54272:FORV=LTOL+24:POKEV,0:NEXT:POKEL
  +1,50:POKEL+24,143                    :rem 128
5 POKEL+5,17:POKEL+6,0:SY=53253:POKE53252
  ,167:POKE 2042,255:POKE53277,4        :rem 57
7 GOSUB77:GOSUB365:SYS 16436:POKE53265,PE
  EK(53265)OR128                        :rem 11
9 GOSUB355:POKE53281,0:POKE53275,4:POKE53
  288,0                                 :rem 188
11 POKE16645,15:PRINT"{CLR}":SYS 16610:PO
   KE832,0:POKE53289,0:POKE53271,4
                                        :rem 251
13 POKE53269,7:POKE53248,150:Y=53249:POKE
   Y,173:POKE53280,1                    :rem 88
15 PRINT"{HOME}{18 DOWN}{GRN}[40 £]"
                                        :rem 218
17 LI=3:C=240:D=243:S=1:P=129:POKE828,0:D
   E=0:POKE16404,0:POKE53279,0:SC=0:S1=0
                                        :rem 1
19 POKE53265,PEEK(53265)AND127:POKE53278,
   0:FM=99                              :rem 252
21 FORA=CTOD:POKEV1,A:POKEV2,P          :rem 188
23 PO=V3-PEEK(V4):IFPO<V5THENPO=V5
                                        :rem 188
25 POKEV6,PO:GETA$:IFA$=R$ANDQ<=.THENA=D:
   C=247:D=250:Q=9:S=.9:P=33:S1=5       :rem 65
27 IFA$=J$ANDQ<=.THENA=D:Q=18:S=3:S1=2
                                        :rem 31
29 IFA$=S$ANDQ<=.THENA=D:C=252:D=252:Q=.4
   :S=.07:P=128:S1=2                    :rem 142
31 IF(PEEK(V7)<>V9)OR(PEEK(V8)<>V9)THENSC
   =SC+S1:S1=.                          :rem 191
33 POKEV2,VA:POKEY,VB-Q:POKESY,VC-Q:Q=Q-S
   :IFQ<=.THENC=240:D=243:Q=0:P=129
                                        :rem 138
35 IF(PEEK(VD)ANDVF)THEN47              :rem 97
37 U=PEEK(V4)/VE:IFU=INT(U)THENPOKEVG,U+V
   H                                    :rem 247
39 SC=SC+PEEK(VI):POKEVI,.              :rem 119
41 IFSC>FMTHENFM=FM+100:LI=LI+1:FORQQ=15T
   O1STEP-1:POKE53280,QQ:NEXT           :rem 44
43 IF(PEEK(V7)<>V9)OR(PEEK(V8)<>V9)THENSC
   =SC+S1:S1=.                          :rem 194
45 NEXT:GOTO 21                         :rem 126
47 POKE53265,PEEK(53265)OR128:POKEL+6,88:
   POKE53269,3                          :rem 5
49 POKEL+4,33:FORZ=244TO246:POKE2040,Z:FO
   RTD=1TO75:POKEL+1,TD:NEXT:NEXT       :rem 28
51 POKE{2 SPACES}L+4,32:POKEL+6,0       :rem 67
53 PRINT"{WHT}{HOME}{20 DOWN}{14 SPACES}S
   CORE"SC                              :rem 183
55 POKE198,0:LI=LI-1:IFLI=0THEN69:rem 255
57 PRINT"{WHT}{DOWN}{11 SPACES}MEN REMAIN
   ING"LI                               :rem 98
58 FORTD=1TO2000:NEXT                   :rem 56
59 PRINT"{HOME}{20 DOWN}{39 SPACES}"
                                        :rem 166
61 PRINT"{DOWN}{36 SPACES}"             :rem 73
62 PRINT"{HOME}{2 DOWN}"TAB(12)"HIT SPACE
    BAR":WAIT198,1:PRINT"{HOME}{2 DOWN}"T
   AB(12)"{13 SPACES}"                  :rem 224
63 POKE 16404,0:POKE53265,PEEK(53265)AND1
   27                                   :rem 117
65 FORTD=1TO150:NEXT:Q=0:POKE53288,0:POKE
   832,0:POKE53251,0:POKE53278,0        :rem 198
67 POKE53279,0:POKE53269,7:GOTO 25
                                        :rem 177
69 PRINT"{2 DOWN}{WHT}{4 SPACES}DO YOU WA
   NT TO PLAY AGAIN? (Y/N)"             :rem 208
71 GETA$:IFA$<>"Y"ANDA$<>"N"THEN71
                                        :rem 205
73 IF A$="Y"THEN11                      :rem 201
75 POKE828,0:SYS828                     :rem 116
77 R$="F":J$="J":S$="S":PRINT"{CLR}{WHT}
   {3 DOWN} {15 RIGHT}ACROBAT"          :rem 40
79 PRINT"{2 DOWN}{7 SPACES}{RVS}F{OFF}
   {3 SPACES}MAKES THE ACROBAT FLIP"
                                        :rem 198
81 PRINT"{2 DOWN}{7 SPACES}{RVS}J{OFF}
   {3 SPACES}MAKES THE ACROBAT JUMP"
                                        :rem 212
83 PRINT"{2 DOWN}{7 SPACES}{RVS}S{OFF}
   {3 SPACES}MAKES THE ACROBAT SLIDE"
                                        :rem 20
85 PRINT"{3 DOWN}{12 SPACES}HIT E TO EDIT
    KEYS"                               :rem 160
87 PRINT"{2 DOWN}{10 SPACES}ANY OTHER KEY
    TO START"                           :rem 230
89 GETA$:IFA$=""THEN89                  :rem 5
91 IFA$<>"E"THEN99                      :rem 2
92 PRINT"{CLR}{2 DOWN} YOU MUST ENTER LET
   TERS BETWEEN A AND Z"                :rem 80
93 PRINT"{2 DOWN}{13 SPACES}KEY TO FLIP?"
   ;:GOSUB600:R$=A$                     :rem 50
95 PRINT"{2 DOWN}{13 SPACES}KEY TO JUMP?"
   ;:GOSUB600:J$=A$                     :rem 61
97 PRINT"{2 DOWN}{13 SPACES}KEY TO SLIDE?
   ";:GOSUB600:S$=A$                    :rem 125
99 PRINT"{2 DOWN}{13 SPACES}PLEASE WAIT..
   ."                                   :rem 222
101 FORA=15360TO16383:READB:POKEA,B:NEXT
                                        :rem 199
103 V1=2040:V2=54276:V3=15:V4=828:V5=7:V6
    =16645:V7=1718:V8=1678:V9=32:VA=128
                                        :rem 52
105 VB=173:VC=164:VD=53279:VE=3:VF=1:VG=5
    1242:VH=49:VI=1000:RETURN           :rem 218
107 DATA0,0,0,0,0,0,0,0                 :rem 102
109 DATA0,0,0,0,0,28,0,0                :rem 162
111 DATA28,0,0,248,0,3,112,0            :rem 112
113 DATA6,112,0,12,127,0,0,112          :rem 206
115 DATA0,0,112,0,0,112,0,0              :rem 45
117 DATA072,0,0,132,0,0,130,0           :rem 154
119 DATA0,130,0,0,132,0,0,136           :rem 157
121 DATA0,1,4,0,0,128,0,111              :rem 53
123 DATA0,0,0,0,0,0,0,0                 :rem 100
125 DATA0,0,0,0,0,28,0,0                :rem 160
127 DATA028,0,0,248,0,1,240,0           :rem 167
129 DATA1,240,0,1,255,0,0,112           :rem 162
131 DATA0,0,112,0,0,112,0,0              :rem 43
133 DATA72,0,0,132,0,0,130,0            :rem 104
```

```
135 DATA1,2,0,2,4,0,4,8           :rem 124
137 DATA0,2,4,0,0,0,0,111         :rem 210
139 DATA0,0,0,0,0,0,0,0           :rem 107
141 DATA0,0,0,0,0,28,0,0          :rem 158
143 DATA28,0,0,248,0,0,240,0      :rem 116
145 DATA0,252,0,0,255,0,0,112     :rem 161
147 DATA0,0,112,0,0,112,0,0        :rem 50
149 DATA72,0,0,136,0,0,136,0      :rem 121
151 DATA1,8,0,2,8,0,4,8           :rem 132
153 DATA0,2,4,0,0,0,0,111         :rem 208
155 DATA0,0,0,0,0,0,0,0           :rem 105
157 DATA0,0,0,0,0,28,0,0          :rem 165
159 DATA28,0,0,248,0,1,112,0      :rem 122
161 DATA2,114,0,4,124,0,0,112     :rem 157
163 DATA0,0,112,0,0,112,0,0        :rem 48
165 DATA96,0,15,192,0,16,64,0     :rem 188
167 DATA0,64,0,0,64,0,0,64         :rem 26
169 DATA0,0,96,0,0,0,0,111         :rem 16
171 DATA0,0,0,0,0,0,0,0           :rem 103
173 DATA0,0,0,0,0,28,0,0          :rem 163
175 DATA28,0,0,120,0,0,112,0      :rem 108
177 DATA0,114,0,0,124,0,0,112     :rem 158
179 DATA0,0,112,0,0,112,0,0        :rem 55
181 DATA96,0,0,96,0,0,96,0         :rem 37
183 DATA0,96,0,0,96,0,0,96         :rem 39
185 DATA0,0,112,0,0,0,0,111        :rem 51
187 DATA0,0,0,0,0,0,0,0           :rem 110
189 DATA0,0,0,0,0,0,0,0           :rem 112
191 DATA0,0,0,0,0,0,63,128         :rem 13
193 DATA0,127,192,0,127,248,0,112:rem 125
195 DATA56,0,112,56,0,112,0,0     :rem 171
197 DATA96,0,0,96,0,0,96,0         :rem 44
199 DATA0,96,0,0,96,0,0,96         :rem 46
201 DATA0,0,112,0,0,0,0,111        :rem 40
203 DATA0,0,0,0,0,0,0,0            :rem 99
205 DATA0,0,0,0,0,0,0,0           :rem 101
207 DATA0,0,0,0,0,0,63,0          :rem 160
209 DATA0,127,128,0,127,128,0,115:rem 122
211 DATA128,0,115,128,0,99,128,0   :rem 76
213 DATA110,0,0,110,0,0,96,0      :rem 103
215 DATA0,96,0,0,96,0,0,96         :rem 35
217 DATA0,0,112,0,0,0,0,111        :rem 47
219 DATA0,0,0,0,0,0,0,0           :rem 106
221 DATA0,0,0,0,0,0,0,0            :rem 99
223 DATA0,0,0,0,0,0,0,0           :rem 101
225 DATA0,63,0,12,127,128,6,115    :rem 21
227 DATA128,3,115,128,1,227,128,0:rem 128
229 DATA238,0,0,14,0,0,0,0         :rem 13
231 DATA0,0,0,0,0,0,0,0           :rem 100
233 DATA0,0,0,0,0,0,0,111         :rem 201
235 DATA0,0,0,0,0,0,0,0           :rem 104
237 DATA0,0,0,0,0,0,0,0           :rem 106
239 DATA0,0,0,0,0,1,0,0           :rem 109
241 DATA1,143,0,0,223,128,0,115     :rem 7
243 DATA128,0,35,128,0,195,128,0   :rem 79
245 DATA255,0,0,62,0,0,0,0         :rem 13
247 DATA0,0,0,0,0,0,0,0           :rem 107
249 DATA0,0,0,0,0,0,0,111         :rem 208
251 DATA0,0,0,0,0,0,0,0           :rem 102
253 DATA0,0,0,0,0,0,0,0           :rem 104
255 DATA0,0,0,112,0,0,119,0        :rem 57
257 DATA1,199,128,1,206,192,1,206:rem 137
259 DATA96,1,254,48,0,252,0,0     :rem 190
261 DATA0,0,0,0,0,0,0,0           :rem 103
263 DATA0,0,0,0,0,0,0,0           :rem 105
265 DATA0,0,0,0,0,0,0,111         :rem 206
267 DATA0,0,0,0,0,0,0,0           :rem 109
269 DATA0,0,0,0,0,0,0,0           :rem 111
271 DATA0,0,0,124,0,0,255,0        :rem 59
273 DATA1,195,0,1,196,0,1,206     :rem 180
275 DATA0,1,251,0,0,241,128,0     :rem 167
277 DATA0,128,0,0,0,0,0,0         :rem 217
279 DATA0,0,0,0,0,0,0,0           :rem 112
281 DATA0,0,0,0,0,0,0,111         :rem 204
283 DATA0,0,0,0,0,0,0,0           :rem 107
285 DATA0,0,0,0,0,0,0,0           :rem 109
287 DATA0,0,0,0,0,0,0,0           :rem 111
289 DATA0,63,0,12,127,128,6,115    :rem 31
291 DATA128,3,115,128,1,227,128,0:rem 129
293 DATA238,0,0,14,0,0,0,0         :rem 14
295 DATA0,0,0,0,0,0,0,0           :rem 110
297 DATA0,0,0,0,0,0,0,111         :rem 211
299 DATA0,0,0,0,0,0,0,0           :rem 114
301 DATA0,0,0,0,0,0,0,0            :rem 98
303 DATA0,0,0,0,0,0,0,0           :rem 100
305 DATA0,0,0,0,0,0,0,0           :rem 102
307 DATA0,96,0,0,240,0,0,255      :rem 121
309 DATA248,0,31,254,0,8,133,0    :rem 230
311 DATA7,2,128,0,2,128,0,5        :rem 73
313 DATA0,0,10,0,0,27,0,0         :rem 207
315 DATA0,0,0,0,0,0,0,0,32,224,0,97,16,0,34
    ,8,0,34,8,0,34,8,0,34,8,0,34,8,0,33,1
    6                              :rem 11
317 DATA0,112,224,0,0,0,0,0,0,0,0,0,0,0,0
                                   :rem 93
319 DATA0,0,0,0,0,0,0,0,0,0        :rem 35
321 DATA0,0,0,0,0,0,0,0,0,0        :rem 28
323 DATA012,0,0,50,7,128,9,8      :rem 129
325 DATA64,6,243,128,2,0,128,1    :rem 234
327 DATA3,0,0,132,0,0,120,0        :rem 54
329 DATA0,40,0,0,40,0,0,84         :rem 16
331 DATA0,0,0,0,0,0,0,0           :rem 101
333 DATA0,0,0,0,0,0,0,0           :rem 103
335 DATA0,0,0,0,0,0,0,0           :rem 105
337 DATA0,0,0,0,0,0,0,0           :rem 107
339 DATA0,0,0,0,0,0,0,0           :rem 109
341 DATA0,0,3,255,0,63,255,1      :rem 123
343 DATA255,255,015,255,255,63,255,255
                                   :rem 143
345 DATA255,255,255,255,255,255,63,255
                                   :rem 151
347 DATA255,15,255,255,1,255,255,0
                                   :rem 191
349 DATA063,255,0,3,255,0,0,0     :rem 178
351 DATA0,0,0,0,0,0,0,0           :rem 103
353 DATA0,0,0,0,0,0,0,0           :rem 105
355 REM MOUNTAIN MAKER             :rem 92
357 O=50688:FORA=1TO76:READB:IFB<ØTHEN361
                                   :rem 238
359 O=O+1:POKEO,78:FORC=1TOB-1:O=O-255:PO
    KEO,78:NEXT:NEXT:GOTO363      :rem 114
361 O=O+1:POKEO,77:FORC=1TOABS(B)-1:O=O+2
    57:POKEO,77:NEXT:NEXT         :rem 129
363 POKE51238,4:POKE51239,1:POKE51240,25:
    RETURN                         :rem 10
365 FORA=16384TO16891:READI:POKEA,I:NEXT:
    RETURN                          :rem 6
367 DATA162,15,169,120,141,23,64,169
                                   :rem 37
369 DATA4,141,24,64,169,192,141,21
                                   :rem 191
371 DATA64,160,39,185,0,0,153,0    :rem 29
373 DATA0,136,16,247,238,21,64,173
                                   :rem 190
375 DATA23,64,24,105,40,141,23,64:rem 129
377 DATA173,24,64,105,0,141,24,64:rem 134
379 DATA202,208,222,96,32,86,64,169:rem 1
381 DATA199,141,22,208,169,16,141,17
                                   :rem 38
383 DATA208,169,255,141,15,212,169,128
                                   :rem 142
385 DATA141,18,212,169,192,141,21,64
                                   :rem 33
387 DATA169,0,141,20,64,96,160,0   :rem 88
```

```
389 DATA169,32,153,0,192,200,208,250
                                        :rem 31
391 DATA238,92,64,173,92,64,201,208
                                        :rem 250
393 DATA208,236,169,192,141,92,64,169
                                        :rem 105
395 DATA160,141,18,208,169,27,141,17
                                        :rem 38
397 DATA208,169,127,141,13,220,169,145
                                        :rem 141
399 DATA141,20,3,169,64,141,21,3   :rem 84
401 DATA169,129,141,13,220,141,26,208
                                        :rem 69
403 DATA96,234,173,25,208,41,1,240
                                        :rem 181
405 DATA42,141,25,208,206,22,208,173
                                        :rem 21
407 DATA22,208,201,192,208,26,238,20
                                        :rem 23
409 DATA64,173,20,64,201,216,208,8
                                        :rem 186
411 DATA32,198,64,169,0,141,20,64:rem 135
413 DATA32,0,64,169,199,141,22,208
                                        :rem 188
415 DATA76,188,254,76,109,65,238,60:rem 6
417 DATA3,173,60,3,74,74,144,18    :rem 41
419 DATA169,255,141,33,65,169,0,32
                                        :rem 196
421 DATA91,65,169,1,141,41,208,76:rem 141
423 DATA241,64,169,7,32,91,65,169:rem 153
425 DATA192,141,33,65,169,0,141,41
                                        :rem 183
427 DATA208,32,77,65,160,0,169,41:rem 143
429 DATA133,251,169,206,133,252,32,68
                                        :rem 87
431 DATA65,24,101,251,105,15,133,251
                                        :rem 12
433 DATA165,251,201,208,144,1,96,173
                                        :rem 29
435 DATA27,212,16,35,32,68,65,170:rem 141
437 DATA189,243,65,145,251,173,27,212
                                        :rem 93
439 DATA201,192,144,214,32,68,65,74
                                        :rem 246
441 DATA101,251,133,251,32,68,65,170
                                        :rem 22
443 DATA189,243,65,145,251,208,195,198
                                        :rem 156
445 DATA252,32,68,65,170,189,243,65:rem 0
447 DATA145,251,208,182,173,27,212,74
                                        :rem 88
449 DATA74,74,74,74,96,162,0,169  :rem 115
451 DATA32,157,0,206,157,0,205,232
                                        :rem 173
453 DATA208,247,96,162,0,157,0,216
                                        :rem 191
455 DATA157,0,217,157,0,218,157,0:rem 136
457 DATA219,232,208,241,96,173,64,3
                                        :rem 249
459 DATA208,60,173,60,3,201,6,144:rem 134
461 DATA96,74,74,176,92,173,27,212
                                        :rem 208
463 DATA201,254,144,85,169,254,141,249
                                        :rem 143
465 DATA7,169,1,141,64,3,173,27    :rem 44
467 DATA212,16,7,169,170,141,3,208
                                        :rem 189
469 DATA208,5,169,184,141,3,208,169:rem 0
471 DATA80,141,2,208,169,2,141,16:rem 131
473 DATA208,169,1,141,40,208,56,173
                                        :rem 241
475 DATA2,208,233,2,144,5,141,2    :rem 26
477 DATA208,208,30,173,30,208,169,255
                                        :rem 91
479 DATA141,2,208,173,16,208,208,12
                                        :rem 237
481 DATA169,0,141,2,208,169,0,141:rem 131
483 DATA64,3,240,5,169,0,141,16    :rem 34
485 DATA208,201,145,208,19,173,30,208
                                        :rem 82
487 DATA41,3,201,3,240,10,169,253:rem 128
489 DATA141,249,7,169,10,141,232,3
                                        :rem 192
491 DATA76,49,234,42,87,81,88,90  :rem 118
493 DATA83,65,160,255              :rem 71
495 DATA 4,-4,4,-4,4,-4,4,-4,4,-4  :rem 49
497 DATA 3,-3,4,-4,2,-2,3,-3,2,-2,4,-4,2,
    -2                             :rem 253
499 DATA 2,-2,4,-4,4,-3,3,-4,4,-4,3,-3
                                        :rem 26
501 DATA 3,-3,3,-3,2,-3,3,-2,2,-3,3,-2,4,
    -4                             :rem 239
503 DATA 4,-4,2,-4,4,-2,4,-4,4,-2,2,-4
                                        :rem 12
505 DATA 4,-4,4,-4,4,-4,4,-4,4,-4  :rem 41
507 DATA 4,-4,4,-4                 :rem 100
600 POKE198,0                      :rem 195
605 GETA$:IFA$<"A"ORA$>"Z"THEN605:rem 123
610 PRINTA$:RETURN                 :rem 163
```

Program 3: VIC Acrobat, Part 1

Refer to "COMPUTE!'s Guide For Typing In Programs" article before typing this program in.

```
0 POKE52,26:POKE56,26:POKE55,0:POKE51,0:P
  RINT"{CLR}{3 DOWN}{8 SPACES}ACROBAT"
                                        :rem 233
1 PRINT"{2 DOWN}{5 SPACES}USE THESE KEYS"
                                        :rem 198
2 PRINT"{2 DOWN}{7 SPACES}{RVS}J{OFF} TO
  {SPACE}JUMP":PRINT"{DOWN}{7 SPACES}
  {RVS}S{OFF} TO SLIDE":PRINT"{DOWN}
  {7 SPACES}{RVS}F{OFF} TO FLIP" :rem 237
3 PRINT"{2 DOWN}{6 SPACES}PLEASE WAIT
  {WHT}"                                :rem 26
8 FORA=7168TO7679:POKEA,PEEK(A+25600):NEX
  T                                     :rem 33
10 READA:IFA=-1THEN12              :rem 245
11 FORB=7168+A*8TO7175+A*8:READC:POKEB,C:
   NEXT:GOTO10                       :rem 177
12 READA:IFA=-1THEN15              :rem 250
13 Q=Q+1:POKE6655+Q,A:GOTO12       :rem 157
15 S$="LO"+CHR$(34)+"AC"+CHR$(34)+",8:"+C
   HR$(131):REM CHANGE 8 TO 1 FOR TAPE
                                        :rem 52
16 FORI=1TOLEN(S$):POKE630+I,ASC(MID$(S$,
   I)):NEXT:POKE198,I:END            :rem 94
21 DATA23,0,12,12,24,24,28,30,14   :rem 54
31 DATA24,12,10,10,10,18,50,34,1   :rem 48
41 DATA25,0,0,6,6,8,29,46,76       :rem 140
51 DATA26,12,12,12,60,72,8,8,12    :rem 19
61 DATA27,0,0,3,3,30,44,76,143     :rem 224
71 DATA28,12,10,17,18,20,18,32,16:rem 120
81 DATA29,0,0,6,6,4,28,28,30       :rem 133
91 DATA30,140,10,18,17,34,68,130,64
                                        :rem 225
101 DATA33,0,28,62,51,27,12,120,0:rem 105
111 DATA34,0,64,76,94,118,38,28,24
                                        :rem 189
121 DATA35,0,30,48,216,204,124,56,0
                                        :rem 214
131 DATA36,24,56,100,110,122,50,2,0
```

```
                                        :rem 200
141 DATA37,192,192,124,62,3,2,4,8:rem 130
151 DATA38,36,24,255,133,135,133,135,255
                                        :rem 227
161 DATA39,60,124,205,255,252,207,125,60
                                        :rem 222
171 DATA40,63,71,253,133,133,133,134,252
                                        :rem 216
181 DATA41,60,126,223,127,63,255,126,60
                                        :rem 173
191 DATA42,4,6,5,4,116,252,248,112
                                        :rem 177
201 DATA43,195,231,126,60,60,126,231,195
                                        :rem 220
211 DATA44,24,24,102,102,24,24,60,0
                                        :rem 202
221 DATA45,0,60,126,126,126,126,60,0
                                         :rem 8
231 DATA46,1,2,4,8,16,32,64,128    :rem 26
241 DATA47,128,64,32,16,8,4,2,1    :rem 28
251 DATA58,127,251,192,192,192,192,192,22
    4                               :rem 85
261 DATA59,120,252,204,196,220,220,192,22
    4,-1                            :rem 201
271 DATA169,30,133,252,169,44,133,251
                                        :rem 82
281 DATA162,16,160,1,177,251,136,145
                                        :rem 28
291 DATA251,200,200,192,22,208,245,189
                                        :rem 125
301 DATA60,3,136,145,251,24,165,251
                                        :rem 225
311 DATA105,22,133,251,165,252,105,0
                                         :rem 7
321 DATA133,252,202,208,221,96,169,32
                                        :rem 75
331 DATA160,16,153,60,3,136,16,250
                                        :rem 173
341 DATA173,240,3,201,6,208,18,173
                                        :rem 177
351 DATA241,3,201,46,208,3,238,240
                                        :rem 174
361 DATA3,169,46,141,241,3,76,113:rem 135
371 DATA26,201,15,208,18,173,241,3
                                        :rem 178
381 DATA201,47,208,3,206,240,3,169
                                        :rem 182
391 DATA47,141,241,3,76,113,26,32:rem 133
401 DATA148,224,165,141,16,231,76,63
                                         :rem 29
411 DATA26,173,241,3,172,240,3,153
                                        :rem 173
421 DATA60,3,206,242,3,208,36,32   :rem 73
431 DATA148,224,165,141,74,74,74,74
                                        :rem 249
441 DATA74,168,24,109,243,3,141,242
                                        :rem 235
451 DATA3,74,144,9,185,167,26,141:rem 146
461 DATA61,3,76,163,26,185,167,26:rem 150
471 DATA141,62,3,32,0,26,96,38     :rem 242
481 DATA39,40,41,42,43,44,45,-1    :rem 28
```

Program 4: VIC Acrobat, Part 2

Refer to "COMPUTE!'s Guide For Typing In Programs" article before typing this program in.

```
0 B1=48:B2=50:B3=9:B4=8039:B5=8061:B6=670
  2:B7=36879                            :rem 254
1 GOSUB500:GOTO5                        :rem 238
2 PRINT"{HOME}{WHT}{2 SPACES}SCORE"SC"
  {3 SPACES}MEN"LI:RETURN                :rem 0
5 POKE36879,8:POKE1008,9:POKE1009,47
                                        :rem 58
10 GOSUB160:POKE36878,15:POKE36869,255
                                       :rem 196
15 C=1:D=4:T=240:D1=8041.1:D2=8063.1:Z=32
   :Y=37:LI=3:FL=-1:V1=36876:V2=36877
                                       :rem 204
17 SC=0:GOSUB2                          :rem 87
20 PRINT"{HOME}{2 DOWN}{3 SPACES}PRESS SP
   ACE BAR":WAIT198,1:PRINT"{HOME}
   {2 DOWN}{19 SPACES}":GOSUB 165 :rem 58
25 FORA=CTOD:OQ=Q:OW=W:IFA<5ORA>8THENR1=P
   EEK(D2+W-Q):POKED2-Q+W,L%(A,2):rem 236
30 IFA<>B3THENR2=PEEK(D1+W-Q):POKED1+W-Q,
   L%(A,1)                              :rem 103
35 POKEV,T:GETA$:IFA$="J"ANDQ<=.THENA=D:Q
   =22:R=3:S1=2:T=0                     :rem 241
37 IFG/B2=INT(G/B2)THEN:W=W+1:IFW>11THENW
   =11                                  :rem 219
40 POKEV,.:IFA$="F"ANDQ<=.THENA=D:C=5:D=8
   :Q=.1:S=.025:S1=8:V=V1               :rem 19
45 IFA$="S"ANDQ<=.THENA=D:C=9:D=9:Q=.1:S=
   .03:S1=2:T=0                         :rem 126
50 IFPEEK(B4)<>ZORPEEK(B5)<>ZTHENSC=SC+S1
   :S1=0:GOSUB2                         :rem 116
60 IFR1>YORR2>YTHENA=D:FL=.             :rem 243
65 G=G+1:IFG/B1=INT(G/B1)THENPOKEB7,B3
                                        :rem 30
75 Q=Q-S:IFQ<=.THENQ=.:C=1:D=4:T=245:V=V2
                                        :rem 12
80 R=R-1:IFR=.THENQ=.                   :rem 24
85 IFA<5ORA>8THENPOKED2-OQ+OW,Z         :rem 254
90 IFA<>B3THENPOKED1+OW-OQ,Z            :rem 31
95 SYSB6:NEXT:POKEB7,8:IFFLGOTO25:rem 159
100 POKE8040,32:POKE8062,32:FL=-1:POKE804
    0+W,32:POKE8062+W,32:R1=0:R2=0:rem 55
105 POKE8041+W,32:POKE8063+W,58:FORU=180T
    0110STEP-1:POKEV1,U:IFU=145THENPOKE80
    63+W,59                             :rem 198
110 NEXT:LI=LI-1                        :rem 208
111 FORJ=38805TO38805++W:POKEJ,2:FORR=1TO
    3:FORTD=250TO255:POKEV1,TD:NEXT:SC=SC
    +10                                 :rem 81
114 GOSUB2:NEXT:NEXT:POKEV1,0:IFLI=0THEN1
    20                                  :rem 19
115 GOTO20                              :rem 50
120 POKE36879,8:GOSUB2                  :rem 35
130 PRINT"{HOME}{20 DOWN}{6 SPACES}GAME O
    VER"                                :rem 34
135 PRINT"{DOWN} S TO START Q TO QUIT";
                                        :rem 113
140 GETA$:IFA$<>"S"ANDA$<>"Q"THEN140
                                        :rem 36
145 IFA$="S"THENRUN                     :rem 134
150 POKE828,0:SYS828                    :rem 158
160 FORA=1TO9:READL%(A,1),L%(A,2):NEXT:RE
    TURN                                :rem 223
165 PRINT"{CLR}{18 DOWN}{GRN}((((((((((
    ((((((((((":W=0:GOSUB2              :rem 170
170 POKE1010,30:FORA=1TO22:SYS6702:NEXT:R
    ETURN                               :rem 138
175 DATA23,24,25,26,27,28,29,30,33,32,34,
    32,35,32,36,32,32,37                :rem 223
500 POKE36869,240:POKE36879,8           :rem 116
505 PRINT"{CLR}{4 DOWN}{WHT}{2 SPACES}CHO
    OSE DIFFICULTY":PRINT"{DOWN} (1-3) 1
    {SPACE}IS THE MOST":PRINT"{DOWN}
    {2 SPACES}DIFFICULT"                :rem 160
510 GETA$:IFA$<"1"ORA$>"3"THEN510 :rem 58
520 PRINT"{CLR}":POKE1011,VAL(A$)+2:POKE3
    6869,255:RETURN                 :rem 164 ©
```

Dinosaurs

M. C. Ware

Requirements: Apple II-series with at least 48K RAM and a disk drive, or a Commodore 64 with a disk drive.

Many computer programs targeted at preschoolers have been disappointing: They either teach alphabet letters or numbers, or merely "do something" for each keypress.

But *Dinosaurs* is different. It's a set of educational games designed for children 2½ to 5 years old which is significantly more interesting than many earlier programs.

Dinosaurs comes in a slipcase containing a disk, an instruction booklet for parents, descriptions of the games, some suggestions for additional (noncomputer) activities for the children, and primary-level reading material about dinosaurs.

When Katherine, my tester, arrived, I had the disk booted and the colorful title screen showing on the monitor. Katherine appeared to enjoy the title page, which is complete with a large dinosaur. I advanced to the menu screen by pressing RETURN. The five choices are arranged by difficulty, and each is represented on the menu by a picture indicating what the game is about.

Identifying Dinosaurs

In the first game, there are five dinosaurs across the top of the screen and a simple scene (trees, land) below them. One dinosaur then appears in the bottom scene and rises to an area just below the silhouettes. The child's task is to line up the dinosaur with the matching picture (using left and right arrow keys) and then press RETURN.

When all five dinosaurs have been matched, dinosaurs parade across the bottom of the screen, accompanied by unusual music. If uninterrupted, the same game begins again. If you don't want the same game, a keypress returns you to the menu. To save time, I made all the menu selections in my trial with Katherine.

We went immediately to the second game (which became Katherine's favorite). In this one, the child must distinguish herbivores from carnivores. The screen shows a pile of bones and a pile of plants. When a dinosaur appears, the child must move it one step to the right (for bones) or one step to the left (for plants), then press RETURN. If the child selects correctly, the dinosaur gets a bite of dinner. This game has the best animation of all the games in the package.

Matching The Habitats

The third game reveals a scene with land, water, and air. After a dinosaur appears, the goal is to move it to its proper habitat. To move a dinosaur to another setting (that is, air for the pteranodon and water for the ichthyosaurus and brontosaurus), you press the left and right arrow keys. After each correct answer, the dinosaur briefly moves back and forth in its environment.

However, there are two problems with this game. First, the dinosaur originally appears on land, but the scene looks more like an underground tunnel. In fact, Katherine often said "underground" when I asked her where something lived. Second, the creatures have all been designed facing to the right. They parade from left to right, in part to reinforce the child's reading patterns, but any child knows that when something swims or flies back and forth, it turns rather than just going forward and backing up.

The fourth game, though touted as more complex, does not actually seem so—at least not without adult intervention. Several rotating windows at the top of the screen randomly reveal dinosaurs (slot machine-style) until each window stops. There will be one, two, or three windows with matching dinosaurs. A scene appears at the bottom, showing an opening to a cave or tunnel. The opening shows a random parade of dinosaurs moving by, one at a time. When the child sees a match, he or she is supposed to press the RETURN key. Then the dinosaur hops up and appears at the top of the screen. The child continues until all the windows are full. Then another parade of dinosaurs marches by as a reward.

With adult intervention, the child could be encouraged to count the windows, thus revealing how many matching dinosaurs are needed. When all are matched, the child could be asked to count them all, or count the pairs. Without such assistance, however, this is not significantly different from the first game.

The last game also involves trial and error, unless the child already knows something about dinosaurs and the alphabet. This time the child must position a bouncing ball above a dinosaur whose name is shown on the screen. If correct, the name and dinosaur move to the bottom of the screen. When all are matched, the reward is, once again, a dinosaur parade.

Extra Activities

As mentioned above, *Dinosaurs* includes a set of pictures to color, some easy-reading text about the dinosaurs, and a list of additional activities. It's hard to imagine many parents wanting to tackle some of these activities (for example, making mock fossils with plaster of Paris). However, they might be useful in a preschool setting.

Like most educational programs for the very young, *Dinosaurs* requires an adult to get the program up and running. However, some children could probably learn to use it independently or semi-independently *after* an adult carefully introduces it.

As a home-educational package, *Dinosaurs* would serve families with children aged 4 to 7, and younger children may also want to try it. If you're buying it for home use, you should realize that (as with many educational programs for young children) you should spend some time encouraging the child, clarifying the games, and reinforcing the learning. Overall, *Dinosaurs* is a worthwhile package.

Dinosaurs
Advanced Ideas, Inc.
2550 Ninth Street, Suite 104
Berkeley, CA 94710
$34.95 Commodore
$39.95 Apple ©

The Syn Series For Atari:
SynCalc, SynTrend, And SynFile+

Arthur Leyenberger

Requirements: Any Atari computer with at least 48K RAM and a disk drive. Part of SynTrend *also requires Atari BASIC.*

It was a year and a half ago that Synapse announced the Syn Series of software at the June 1983 Summer Consumer Electronics Show (CES). This very ambitious collection of software was going to include programs for word processing, data base management, spreadsheets, telecommunications, stock charting, graphics, and calendar-keeping. All of the programs were going to use similar file structures so they could share data. Prototypes of several of the programs were shown, and they looked easy to use and full of features.

By January 1984, at the Winter CES in Las Vegas, Synapse had struck a deal with Atari for the three major programs in the series. *SynCalc, SynTrend,* and *SynFile+* would be produced by Synapse and marketed exclusively by Atari. The word processor, *SynText,* was canceled to keep it from competing with Atari's *AtariWriter,* and Synapse was free to market the remainder of the Syn Series on its own.

After a long wait, the spreadsheet, graphics, and data base programs are finally available. As promised, *SynCalc, SynTrend,* and *SynFile+* can share the same data files. Also, the three application programs are compatible with *AtariWriter* so that data can be embedded within reports and cosmetically formatted. However, in the wake of Jack Tramiel's purchase of Atari, Synapse will be distributing the entire Syn Series after all.

Let's take a closer look at these programs' strengths and weaknesses.

SynFile+

SynFile+ is an outgrowth of two previous Synapse data base programs. The original one, *FileManager 800,* has been around for several years. It was fairly easy to use but lacked sophisticated features such as field totaling. This problem was addressed by the improved program, *FileManager+,* which became quite popular.

SynFile+ shares many features with the earlier programs, but has been totally rewritten in Forth, resulting in faster sorting and record access. Also, it uses the full 48K of memory to add significant features (the new XL computers have 64K, but Synapse apparently wanted to keep the program compatible with older Ataris as well).

SynFile+ is totally menu-driven and memory-resident. It is very easy to use and does not require you to swap disks when accessing different functions of the program. One of the more useful new features is that your data file disk can be formatted in any of three disk densities: single density, Atari 1050 enhanced density, and true double density. Choosing enhanced or double density allows you to store more records on the disk than allowed by previous versions of the program. You can store your data on up to 16 disks—a lot of capacity, but also a lot of swapping.

There are other new and useful features in *SynFile+*. Mailing labels can now be

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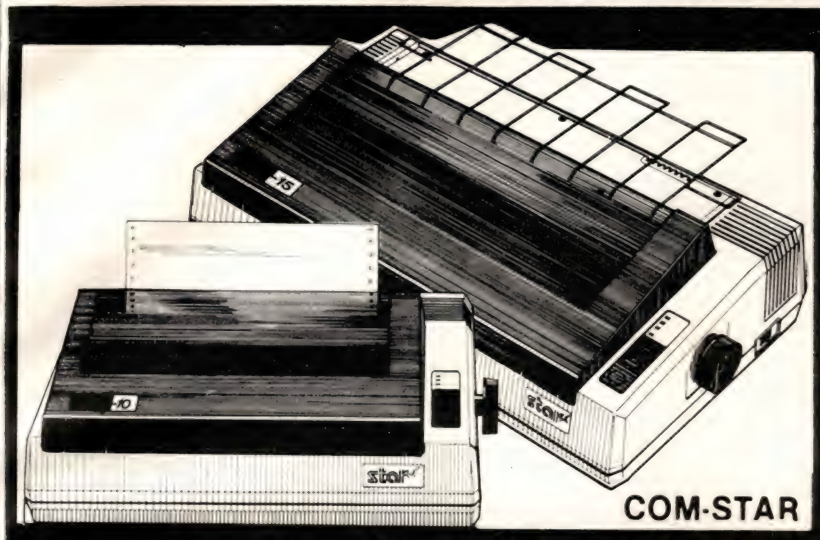

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COM-STAR PLUS+ Print Example:

ABCDEFGHIJKLMNOPQRSTUVWXYZ
ABCDEFGHIJKLMNOPQRSTUVWXYZ 1234567890

printed from one to four labels across. When setting up labels or reports, the screen can be scrolled horizontally up to 232 characters. The print format line is a template for specifying the horizontal layout of your report. The location of field names under the print format line determines how the columns will be placed horizontally. You can use up to 40 field names.

Another worthwhile feature of *SynFile+* is that it can read and write data files in DIF (data interchange format). This lets you pass your data base information to such programs as *SynCalc, SynTrend,* and *VisiCalc.* Also, you can bring DIF data into *SynFile+*. In addition, when creating a report or mailing list, you can direct the output to the screen, printer, or a text file on disk. This text file has a .TXT name extension and can be accessed by *AtariWriter.*

Versatile Field Types

SynFile+ contains quite a few new field types. In addition to the usual text, numeric, computed, and dollar fields, conditional and table lookup fields are allowed. Conditional fields contain a code that is cross-referenced to a text entry. Based upon the value of a previously specified relationship, one of several text entries will be printed in your report. Similarly, table lookup fields contain a code that is cross-referenced to a list of previously defined alternatives. At report time, the matching table entry is printed instead of the particular code.

Other new field types include record numbers initially assigned and incremented by the computer, counters (similar to record numbers except you specify the starting value and the increment), and the date. Once a date has been entered, it will automatically appear on succeeding records so you don't have to enter it for each record. A handy feature.

Retrieving a record with Synapse Software's SynFile+.

SynFile+ comes with a program disk, a tutorial disk, and a 121-page attractively packaged manual. The tutorial disk is a clearly presented, step-by-step introduction to all aspects of the program. The manual is well-written and contains such useful features as a quick reference card, glossary, and index.

SynFile+ does have some inadequacies, though. First, it cannot read previously created *FileManager 800* and *FileManager+* files. If you're converting to *SynFile+*, you have to retype all of the data into the new program. Fortunately, Synapse is working on a utility that will convert the older format files into *SynFile+* format and also provide backups. It's expected to be available late this year.

Another weakness is that *SynFile+* has no report-writer function to let you generate multiple sublevels in a report, each with its own subtotal. Again, Synapse promises a utility/enhancement disk by the end of the year with a sophisticated report generator.

These few complaints aside, *SynFile+* is an excellent data base program for the Atari computer. Its compatibility with the other Syn series software, ease of use, and number of new features make it definitely worthy of consideration for Atari users seeking a quality data base manager. *SynFile+* also works automatically with the Axlon 128K Rampower and Mosaic 64K Select boards.

SynCalc

Of the three Syn Series programs reviewed here, *SynCalc* is clearly the best, offering excellent features and the best value. Compared to the existing spreadsheet programs for the Atari computer, *SynCalc* simply cannot be matched.

SynCalc lets you create various worksheets of text and data for such applications as income taxes, budgets, checkbook balancing, forecasting, and preparing tables.

The spreadsheet itself is a grid of 255 rows and 128 columns, forming over 32,000 cells for entering data. Each cell can contain text, numbers, or a formula. As numbers are entered, results are recalculated and displayed instantly.

Text and data can be easily manipulated throughout the grid. Formulas, numbers, and labels can be copied from one position to other positions. Two parts of the spreadsheet can be viewed simultaneously by using the vertical and horizontal split-screen feature.

What makes *SynCalc* especially attractive is its ease of use. Pop-up menus display the current mode and available functions. With experience, you can eventually issue direct commands without referring to the menus.

When using the menus, the commands are always displayed at the top of the screen. For example, to copy cells A1 through A5 to locations B1 through B5, you'd have to select a total of six menu entries. Alternatively, you can type /C A1:A5 B1:B5. You can type cell addresses directly or move the cursor to a cell and press RETURN.

Flexible Formatting

There are several features unique to this spreadsheet program for the Atari computer. Variable-width columns let you format and display your

worksheet more flexibly. If a particular cell's contents exceed the width of the column, you can still display the entire entry. This text overflow feature may be turned off if desired. Cells can be justified left, right, or centered. If you change column widths, the justifications are automatically readjusted.

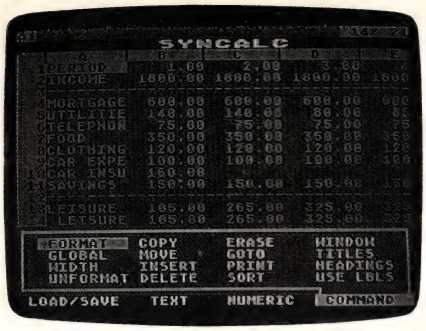
Numeric cells can be displayed in a variety of formats: Fixed-point, floating-point, engineering, and scientific notation, each with up to ten decimal places displayed. A leading dollar sign can be added and commas inserted to make large numbers more readable. There are just too many format options to describe here.

A very powerful feature of *SynCalc* is the ability to sort data entries in alphabetic or numeric order. Sorts can be either ascending or descending. Once you define the block of cells to be sorted, you specify a column for sorting and the upper-left cell of the destination block. Although *SynCalc* can sort on only one column, you can perform multiple sorts by repeating the process.

SynCalc also lets you use one- or two-drive systems; select menus and filenames by pressing just the cursor key (without the CONTROL key); and perform table lookups, conditional tests, and statistical functions. Also, you can format disks from the main menu and save worksheets in either DIF format (for use with *SynFile+* and *SynTrend)* or text format (for use with *AtariWriter*). I've used the *AtariWriter* output feature many times and think it is one of the best features of *SynCalc.*

The 148-page manual is divided into introductory, tutorial, reference, and index sections. Screen shots help clarify examples, and a quick-reference card is included.

Syncalc is an excellent product. It has many more features than *VisiCalc* and is much easier



Setting up a home budget spreadsheet with SynCalc.

to use. The ability to access *VisiCalc* files and to integrate with the other Syn products and *AtariWriter* makes *SynCalc* a "must-have" program for nearly everybody. Once you start using the program, you'll find more uses for it than you expected.

SynTrend

SynTrend is actually composed of two separate programs, SynGraph and SynStat. SynGraph is a high-resolution, color-graphing program, and SynStat is a statistical program for analyzing trends in your data. The package comes with two program disks and a two-section manual.

SynGraph can be used to create four different types of graphs: line plot, bar chart, scatter plot, and pie chart. It will accept data in SynStat, *SynFile+*, *SynCalc,* and *VisiCalc* file formats. Once generated, graphs can be saved to a disk and printed.

SynGraph requires BASIC and works with either one or two disk drives. Working with the program is essentially a two-step process. First, you compile the data files that will be used to create the graphs. Second, you choose the type of graph to make.

The line graph, scatter plot, and bar chart can each display up to three different factors (sets of data). Each factor must exist in a separate data file. The pie chart is created from a single data file, and compares the data points against others within the same file. You can choose labels for titles, X-Y axes, factor names, and pie chart slices. X-Y coordinates may be displayed in either whole numbers or decimals.

Specific scales can be entered for all but the pie charts. When displaying line and scatter plots, autoscaling results in numbers in integer format and divisions of 5 and 10 for X and Y, respectively. Autoscaled bar graphs yield decimal format numbers, Y divisions of 10, and a cluster pattern. A cluster pattern places the factors (a maximum of three) next to each other along the X axis, whereas a stacked pattern places the factors atop each other. Any of the graphs can be rescaled at any time.

Labeled Pie Charts

Pie charts may contain up to 12 slices and are used for graphing one factor. Each slice is labeled (up to seven characters) with its percentage of the whole. If you don't name the slices, the program defaults to labeling them A, B, C, etc.

The strengths of SynGraph are the ease of entering and editing the data and creating the graphs, and the straightforward documentation. Also, the ability to save graphs for future use and a slide-show program that can recall the saved graphs in sequence are useful features.

Unfortunately, SynGraph has a few weaknesses. Files cannot be deleted, renamed, or catalogued without exiting to DOS. The only printers it supports are those from Epson, NEC, and C. Itoh. There is no support for Okidata printers, and problems have been reported using the C. Itoh 8510 Prowriter. Synapse is aware of these problems and is working on a fix. And finally, the program requires the BASIC cartridge but does not alert users of the older 800 and upgraded 400 computers if they forget to plug it in.

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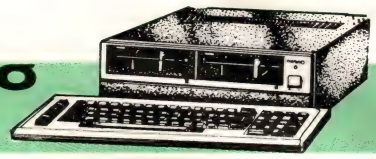

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Overall, SynGraph is a usable program for graphing data, assuming you have a compatible printer. Its ability to access *SynCalc*, *SynFile+*, and *VisiCalc* data make it more than just another graphics program.

SynStat

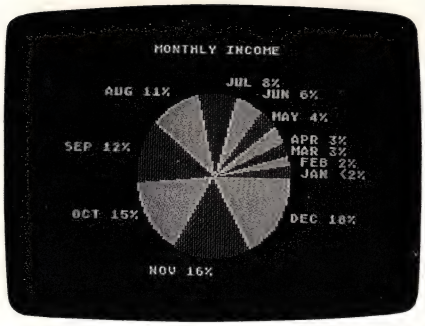
SynStat is a completely menu-driven program for manipulating and analyzing data. You have a choice of descriptive analysis, or simple or multiple regression analysis. Up to four disk drives may be used.

Since SynStat can read or write DIF format files, you can analyze *VisiCalc* data and use *VisiCalc* to read files created with the SynStat data editor. Also, you can format disks directly from the main menu without going to DOS.

The data editor contains several useful commands for transforming columns. Data in one column may be added to data in a second column, with the results appearing in a third column. Likewise, columns of data may be subtracted, multiplied, or divided and the results placed in a third column. You can add or multiply columns by a constant, with the results replacing the original numbers. The natural logarithm of a column of data can also be obtained.

SynStat's descriptive analysis displays eight pieces of information: The number of observations, minimum and maximum values, the range of values, the average, standard deviation, variance, and the standard error.

Regression analysis is a common statistical technique to confirm or deny a hypothesis concerning the relationship between two or more variables. A separate file is used for the independent and dependent variables, and they must contain exactly the same number of observations. SynStat first displays a summary of the data. The coefficient and standard error of the estimate are given for each of the variables. It also displays an overall r-squared (coefficient of determination), adjusted r-squared, and standard error.



A proportioned pie chart created with SynGraph.

If you use two independent variables, SynStat displays a screen of partial correlation coefficients. This information is used to determine how closely the two independent variables are related to each other. The final screen is called the residual analysis screen. Here the actual, predicted, and residual values are shown for the data being analyzed.

The documentation contains some tutorial information on regression analysis, but you should already be familiar with the topic before using the program. Any introductory statistics textbook should do.

The SynStat manual contains a glossary and index in addition to its tutorial and reference section. Since SynStat is part of the *SynTrend* package, careful thought should be given to its usefulness in meeting your needs.

Syn Series Quality

As a whole, *SynFile+*, *SynCalc*, and *SynTrend* represent quality software for the Atari computer. Each has useful features, such as rapid cursor movement and straightforward menu screens, and is easy to use. Their ability to share data with each other and to work with *AtariWriter* are valuable assets. The only feature one might wish for is 80-column capability with the Bit-3 and Austin-Franklin 80-column boards. According to Synapse, there will be new versions of the programs that will work with Atari's 80-column board in the 1090XL expansion box, when or if the box is released. These programs have taken a long time to finally arrive, but the wait has been worth it.

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PC-Write Word Processor For PC & PCjr

Sheldon Leemon

Requirements: IBM PC with at least 64K RAM, any DOS, and a disk drive (128K RAM and DOS 2.0 or higher recommended); or an Enhanced Model PCjr with DOS 2.1.

Although an IBM PC (and even a PCjr) cannot be considered an inexpensive computer, sometimes the cost of the machine seems to be no more than a down payment after you buy the software needed to operate it. Word processing, for example, is one of the most popular applications for personal computers. But many of the most popular commercial word

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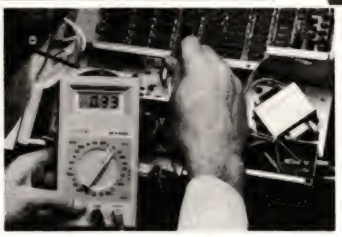

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processing programs for IBM computers cost $400 or more. That's why it's so refreshing to find a program like *PC-Write*—a professionally designed, full-featured word processor that is practically free for the asking.

PC-Write is not commercial software in the usual sense. It is distributed via the *shareware* concept. You're allowed to copy and share the *PC-Write* disk, which contains both the programs and documentation. Indeed, such copying is encouraged, because it's the primary means of distributing the program.

If you don't know anyone who can share *PC-Write* with you, it is available from many user groups, bulletin board systems, and from the publisher, Quicksoft. Quicksoft charges a minimal $10 fee to cover the cost of the disk, postage, and handling. That's a price that is hard to beat.

However, shareware—or user-supported software, as it is also known—is not just an exercise in altruism. Rather, it is a marketing approach that some software authors developed as an alternative to the more traditional channels of commercial software distribution. Its proponents like to compare it with public television. Under the shareware concept, quality software is made freely available to the public without obligation. You can make as many backup copies as you want and try out the program at your leisure. If, after using the program for a while, you decide that it's suitable, you're encouraged to support the efforts of the software developer by making a voluntary contribution. Though a specific amount is usually suggested, any contribution is appreciated.

Chain-Letter Software

PC-Write gives the shareware concept a special twist. If you're satisfied with *PC-Write*, you're asked to register your copy of the program by sending $75 to Quicksoft. This $75 fee is rather modest compared to the price of comparable word processors, and it buys you more benefits than you usually get with commercial software. You receive not only a copy of *PC-Write* personalized with your registration number and a bound manual, but also a telephone number you can call with questions about the software, a copy of the Pascal and machine language source code, and the next major update of the program.

The personal registration number is the key to the most unusual benefit. Whenever you share your personalized copy of *PC-Write* with someone, their copy will bear your registration number. If that person subsequently registers *PC-Write*, Quicksoft mails you a $25 commission. There's no limit to the number of commissions you can earn. Therefore, an aggressive registrant can actually make money by distributing the program to friends and associates, like the software equivalent of a (legal) chain letter.

As attractive as this innovative marketing concept sounds, it is bound to generate some skepticism about the quality and commercial value of the program. You get what you pay for, right? Well, not always.

First, *PC-Write* was programmed by a pro. Designer Bob Wallace has been writing text editors since 1969. He has a master's degree in computer science and worked for Microsoft for a number of years, where he wrote much of the MS-Pascal compiler and runtime package. (*PC-Write* and many other commercial programs are written in MS-Pascal.)

Second, a careful examination of *PC-Write* bears out Wallace's observation that in order to make money from voluntary contributions, a program must be very good indeed.

Separate Editor And Printer Driver

Like all word processing programs, *PC-Write* lets you enter, edit, and format text to print it exactly the way you want it. Unlike most word processors, however, *PC-Write* splits these functions between two separate programs to save memory. This requires you to save your file, exit the editor program, and then load the printer driver program before you can print your document. Fortunately, if you have more than 128K of memory and are using DOS 2.0 or higher, you can keep the editor and your text in memory while running the printer program.

The editor program does most of the real work. It lets you enter text and format the appearance of each line on the screen. All the usual capabilities are supported, such as adjustable margins, centering, and right-margin justification. The *PC-Write* printer driver is used only to divide these lines of text into pages and to properly place headers and footers. Except for special features such as boldfacing, underlining, and subscripts, your text is printed exactly as it looks on the screen. Any line length can be specified, but only 80 columns will appear on the screen at once. To see widths greater than 80 characters, you must scroll the text window right or left.

The editor portion of *PC-Write* is responsive and very powerful, boasting a wide range of features. You can enter text in either insert mode (new characters make room by pushing old characters to the right), or overstrike mode (new characters replace old characters). You toggle between the two modes with the Scroll Lock key on the PC or the Function-S combination on the PCjr.

The wide range of cursor control commands is very logically assigned to the special

keys on the IBM keyboard or to double-key combinations. For example, the left and right arrow keys by themselves move the cursor left or right one character; when pressed with a Shift key, they move the cursor to the left or right of the screen; and when pressed with Shift and Control, they move the cursor left or right one word. Other combinations let you move the cursor to the top or bottom of the screen, the beginning or end of the document, forward or backward one paragraph, and allow you to scroll the whole screen up or down one line or page at time. You can even mark the current cursor position so you can return there later by pressing another double-key combination. In addition, the program internally numbers each line of text. You can see the current line number by pressing Shift-F9 and jump directly to another line by entering its number.

For all of the editing commands, *PC-Write* makes special provisions for the PCjr keyboard so multiple keystrokes aren't required to emulate the full PC keyboard.

On-Line Help Screen

Since so many cursor commands may be a little hard to keep track of, pressing the F1 key brings up a help screen that details all of the special key assignments. You can customize the program, too—permanently assigning any command sequence to one of the Control key combinations. That way, if you are already used to another word processor, you can set up *PC-Write* to emulate it (the default assignments correspond to those used by *WordStar*).

PC-Write also lets you move the cursor to a specific word or series of words using the Search command. You merely designate a search string by pressing F9 and typing in the word or phrase. From then on, a single keypress moves the cursor either forward or backward to the next occurrence of that string in the document. You can even use certain wild card characters in your search string. An F5 character will match any letter or digit, an F6 will match any character except a letter or number, an F7 will match any one character, and an F8 will match an end-of-line character. For example, the search string "comput[F5]" could be used to find both "computer" and "computing"

You can also designate a replacement string. Hitting the F10 key replaces the next occurrence of the search string with the replacement string, and Shift-F10 replaces all occurrences of the search string within the text. There is even an *unreplace* feature so you can switch them back in case you made a mistake!

PC-Write makes it easy to delete, move, and duplicate text. There are single-key commands for deleting a character, a word, or a line. For deleting or moving larger blocks of text, the F6 key lets you start defining sections of your document (this text appears in inverse video). You can use all of the program's powerful cursor movement keys to extend the defined area. For example, a whole paragraph can be marked by pressing F6 and Control-PgDn (next paragraph). When you've defined the paragraph, you can delete it by pressing a single key.

Whenever you delete more than one character at a time, the erased text is moved to a holding area so it can be inserted somewhere else. This feature can also be used to retrieve text that was removed by mistake. Defined blocks can be saved on disk or printed out, and text can be merged into a document from a disk file. You can also duplicate a defined block of text elsewhere in the document.

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Convenience Features

In addition to its clean implementation of standard editing features, *PC-Write* contains many nice extras which are usually found, if at all, in only the most comprehensive (and expensive) word processors. There is a single keystroke combination which transposes two letters, rather than making you delete one letter, move the cursor, and type it in again. Likewise, the F8 key switches lowercase letters to uppercase and vice versa.

When loading a file, the program lets you choose whether you want an automatic backup file created. A keyboard macro feature lets you define any key or combination of keys as any series of characters. This means you can insert commonly used phrases, such as your name, with a single keystroke. It also means you can customize the program's command sequences to make them easier to remember, and frequently used combinations of these commands can be available by pressing one key. The keyboard macros can even be made a permanent part of the *PC-Write* editor by saving them in a disk file.

The level of customization possible with *PC-Write* is truly staggering. You can create special characters which will send any sequence of command codes to the printer, allowing you to create overstrike characters or even dot-matrix graphics characters. You can designate how special characters will appear on the screen, so that underlined text, for example, can be displayed in boldface, inverse, or blinking characters. If you're using a color monitor, you can set the foreground and background colors for regular text, marked text, text which appears between printer control characters, and the status line.

If you're a programmer, the possibilities are endless. Because you can obtain the source code for *PC-Write* by registering your copy, virtually any modification can be made.

Excellent Support

The author's commitment of support is as important as the program's many fine features. One of the advantages of the shareware system is that it opens up dialogue between the software author and users. You can report bugs and suggest improvements, and the unconventional method of distribution frees the author to make changes as often as he wishes. *PC-Write* has undergone a number of revisions within a short period of time. Some of the more recent enhancements include the keyboard macros and the special font characters for turning on boldfacing and underlining.

Inevitably, there are still some features of *PC-Write* that aren't perfect. Even if your computer has enough RAM (at least 128K) to hold both the editor program and printer driver in memory at once, you still can't switch back and forth. It's also inconvenient to have to exit the editor to DOS whenever you need to see a disk directory. And it would be nice if microspace justification were added to the printer driver.

These problems are less important, however, when viewed in context of the program's overall excellence. Moreover, because of the ongoing support of *PC-Write*, there is a pretty fair chance that even these flaws will be cleaned up in a future revision.

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TED: I'M AN ACCOUNTANT...
WHAT DO YOU DO?
JACK: I'M A DENTIST AND I
HAVE A GREAT PRACTICE.
FRED: I HEARD YOU LIVE HAND
TO MOUTH.
JACK: THAT'S IT, YOU GUYS ARE
NUTS. I'LL CHECK IN LATER.

Plus/Term For VIC & 64

Gregg Peele, Assistant Programming Supervisor

Here's a top-notch terminal program that lets you access almost any computer or information service over the phone with your Commodore 64 or VIC-20. Its features include key redefinition, word wrapping, 1200 bps support, uploading, and downloading. Written in BASIC and machine language, the program works on any 64 or VIC with at least 16K RAM and a modem.

There's a lot more out there than you think.

Sure, you can use your home computer to play games, write letters, and balance your budget. But *telecomputing*—communicating with other computers over the phone lines—can let you do even more. "Plus/Term" and a modem turns your home computer into a full-fledged communications terminal. You can link up with the personal computers of your friends, the mainframe computer at work or at school, electronic bulletin boards, on-line data bases, and commercial information services such as CompuServe, The Source, and Dow Jones News/Retrieval.

Plus/Term is designed to make your computer emulate an *asynchronous ASCII terminal.* An asynchronous terminal does not require special timing (sync) characters, and doesn't require the receiving terminal to operate in step with your system. ASCII (American Standard Code for Information Interchange) is a standard character code that computers use to understand each other. Most microcomputer communications are asynchronous and in ASCII.

Typing Plus/Term

Plus/Term consists of two parts: a BASIC program that displays menu options, and a machine language routine that handles the actual communications. The BASIC program (Program 1) is the same for both the VIC and 64, but the machine language programs are different.

First, type in the BASIC portion (Program 1) and save it on tape or disk. To type in the machine language portion, you must use the MLX machine language editor located elsewhere in this issue. Starting and ending addresses for Plus/Term are 50152 and 52561 for the Commodore 64 (Program 2), and 6144 and 8456 for the VIC-20 (Program 3). Before loading MLX to enter Program 3, VIC users must enter the following line in direct mode (without a line number) and press RETURN:

```
POKE 44,35:POKE 256*35,0:NEW
```

Save the machine language portion on tape or disk using the filename referenced in line 100 of the BASIC program (*PLUS/TERM.ML*).

To start Plus/Term, run the BASIC program. It automatically loads the machine language part from tape or disk using the filename in line 100. If you're using tape, change the **,8,1** listed after the filename to **,1,1**.

Important: Before loading the BASIC portion into the VIC, enter this line without a line number and press RETURN:

```
POKE 44,35:POKE 256*35,0:NEW
```

You must enter this line every time you start the VIC version of Plus/Term.

Entering Terminal Mode

When you run Plus/Term, the program asks you to specify a *baud rate.* The baud rate, more properly known as *bps* (bits per second), is the speed at which a modem communicates. Inexpensive modems—including most of those sold for the Commodore 64 and VIC-20—can transmit and receive information at speeds ranging from 110 to 300 bps (about 10 to 30 characters per second). Modems costing $400 or more can usually be switched to 1200 bps to speed up communications by a factor of four.

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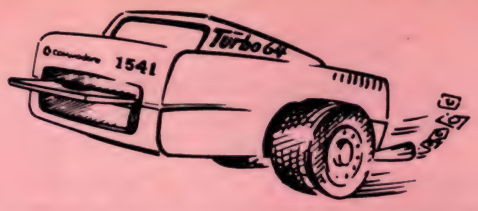

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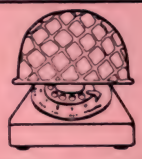

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Remember that the computer at the other end of the phone line must be transmitting and receiving at the same speed as yours. You can't send and receive at 1200 bps if the other computer has only a 300 bps modem. Many electronic bulletin boards and commercial information services are capable of communicating at both 300 and 1200 bps. Some even recognize your baud rate when you first sign on and adjust themselves accordingly. But you still have to set Plus/Term for the proper baud rate each time you run the program.

After you specify the baud rate, Plus/Term enters terminal mode. A cursor appears at the upper-left corner of the screen. The Commodore 64 version of Plus/Term has a blinking underline cursor, and the VIC version has a solid block cursor.

To see how terminal mode works, try typing these two sentences:

This is a test of the Plus/Term software. It is designed to provide lots of options for use with many systems.

Notice how Plus/Term handles words that are typed at the end of a line. Rather than splitting words, Plus/Term moves the entire word to the next line. This feature, known as *word wrap,* makes text easier to read. It's found on most word processors.

You can turn word wrap on or off at any time by calling up a menu. All the main features in Plus/Term are controlled from a main menu and its submenus. When you're in terminal mode, you can flip the screen to the main menu whenever you want by pressing the f7 special function key.

Plus/Term Main Menu

Here's what it looks like:

PARAMETERS
1. WORD LENGTH
2. STOP BITS
3. BAUD RATE
4. PARITY
5. DUPLEX
6. DEFINE KEY
7. TERMINAL OPTIONS
8. RETURN TO TERMINAL
9. RETURN TO BASIC

The first five options control communications parameters. Plus/Term defaults to these settings:

8-bit word length
1 stop bit
300 baud
No parity
Half duplex

Always set your modem to full duplex while using Plus/Term. That way you can control the duplex setting with the program. To change Plus/Term from half duplex to full duplex, press the numeral 5 key to select option 5 from the main menu. The menu goes away and a submenu appears. Again, press the appropriate key to select the option you want (half or full duplex); your choice will be highlighted in reverse video. Press RETURN to go back to the main menu.

All of the other options in Plus/Term work the same way. Just select an option from the main menu and usually another menu will appear.

If you change baud rates from within Plus/Term, all other parameters revert to their default values. Usually you need to set the baud rate only when first running the program.

Never press RUN/STOP–RESTORE in the 64 version of Plus/Term when the menu is on the screen. If you do, the program halts. You can restore it by typing POKE 648,4 and pressing RETURN, but you'll have to type blindly because the operating system thinks the screen is at a different location.

Terminal Mode Commands

You can return to terminal mode from the main menu by selecting option 8 (option 9 exits Plus/Term to BASIC). Notice that the text you left on the screen is still there.

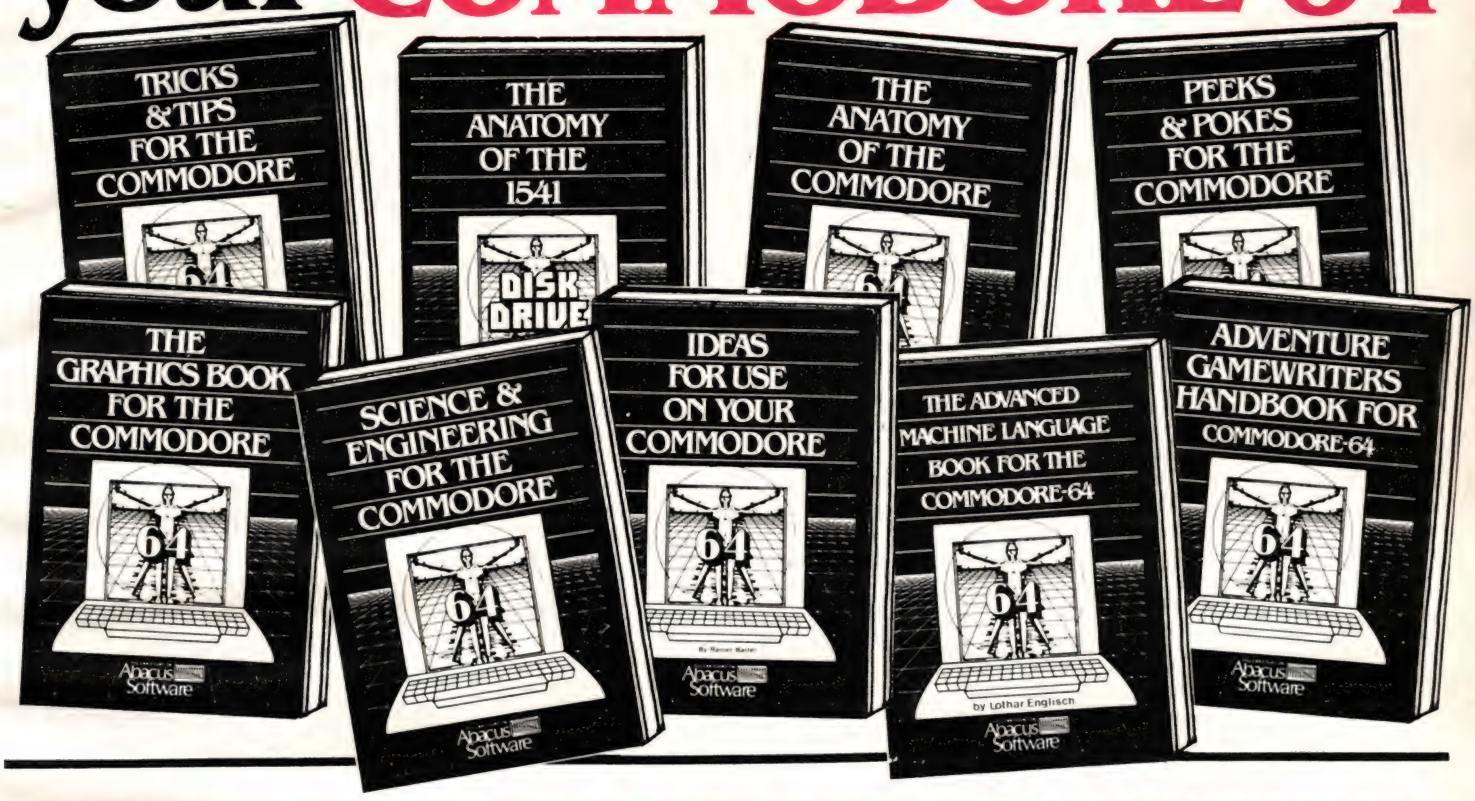
Other keys besides f7 execute commands in terminal mode. You must press three keys simultaneously: Hold down SHIFT and CTRL, then press the appropriate command key (this sequence makes it possible for you to send special control codes in terminal mode by pressing CTRL and a character key). Here are the terminal mode commands:

CTRL-SHIFT-B:	Change background color.
CTRL-SHIFT-F:	Change border color.
CTRL-SHIFT-K:	Change text color.
CTRL-SHIFT-O:	Open buffer (start storing characters in memory).
CTRL-SHIFT-C:	Close buffer (stop storing characters in memory).
CTRL-SHIFT-S:	Save buffer contents on disk or tape.
CTRL-SHIFT-L:	Load buffer contents from disk or tape.
CTRL-SHIFT-Z:	Zero (erase) buffer.

Notice that some of these commands involve the manipulation of a *buffer.* A buffer is an area in memory set aside to store data. If the buffer is open (CTRL–SHIFT-O), all the characters sent and received by your computer are stored in memory. The contents of the buffer can then be saved on disk or tape or sent to a printer. This feature lets you *download* (receive) text files and programs from remote computers. You can also *upload* (send) files to other computers. We'll discuss these procedures in a moment.

The buffer is 30,720 bytes long (about 30K) on a Commodore 64, and 7860 bytes long (about

Required Reading for your COMMODORE 64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7.6K) on a VIC-20 with the 16K memory expander. The file you plan to upload or download must fit in the buffer, unless you handle it in pieces to be assembled later. If the buffer fills up when you're downloading, a screen prompt asks: SAVE BUFFER, YES OR NO? *If you answer no, the contents of the buffer are erased.* Press CTRL-Q to continue your conversation with the other system.

Terminal Options

Option 7 on the main menu, TERMINAL OPTIONS, controls some of the most useful features of Plus/Term. Here's what the terminal options submenu looks like:

1. DIRECTORY (DISK)
2. COMM TO COMM
3. COMM TO ASCII
4. WORD WRAP
5. NORMAL SCREEN
6. PRINT BUFFER
7. LINEFEED WITH RETURN

Option 1 (DIRECTORY) simply lets you call a disk directory without leaving Plus/Term.

Options 2 and 3 (COMM TO COMM and COMM TO ASCII) toggle between each other. Option 3 is the default setting. Plus/Term normally translates Commodore codes into ASCII and vice versa. If you select option 2, Plus/Term stops converting Commodore codes to ASCII. This is useful when communicating with other Commodore systems or when transferring files, as we'll see in a moment. Option 3 also lets you save or load key redefinitions with a tape or disk drive. After you've customized the keys as described below, select option 3 and follow the screen prompts.

Options 4 and 5 (WORD WRAP and NORMAL SCREEN) also toggle back and forth to turn word wrap on or off.

Option 6 (PRINT BUFFER) lets you access the most powerful features of Plus/Term. You can print the contents of the buffer on the screen or a printer, or send it through the RS-232 port (which may be connected to your modem or a serial printer). Whenever you're printing the buffer, you can pause the action by pressing the SHIFT key, slow it by pressing CTRL, or stop it by pressing the space bar. Since some printers may enter graphics mode if certain character codes are sent, you may need to modify the OPEN statement in line 1900 to lock your printer into text mode.

Option 7 (LINEFEED WITH RETURN) lets you disable the linefeed character that normally accompanies the RETURN character. Normally when you press RETURN, two things happen: The cursor jumps to the left side of the screen and also moves down a line. The downward cursor movement is a linefeed. Some remote computers automatically send a linefeed when they receive a RETURN, so the extra linefeed is unnecessary. If option 7 is highlighted, the RETURN character will include a linefeed. Selecting this option toggles linefeeds on and off.

Customizing Plus/Term

We've already mentioned key redefinition briefly. This is a feature usually found only on the better terminal programs, and it requires some explanation. Basically it lets you customize Plus/Term for communicating with a specific remote computer. To use this feature, select option 6 on the main menu.

Here's why it's important. When Plus/Term is in normal ASCII mode, all characters you type are translated into the standard ASCII codes before they are sent over the phone line. This assumes that the other computer also is sending and receiving the same ASCII codes. But some computers occasionally depart from ASCII. For instance, some systems use ASCII code 127 as a delete character, while pressing the INST/DEL key on a Commodore 64 generates ASCII code 20. The result will be a failure to communicate.

Plus/Term lets you redefine any key on the keyboard to send out any ASCII code you want. To redefine the INST/DEL key to send the ASCII code 127 that the other computer expects instead of the ASCII code 20, first you'd select option 6 from the main menu. The following submenu appears:

CHANGE VALUES
1. GOING OUT
2. COMING IN

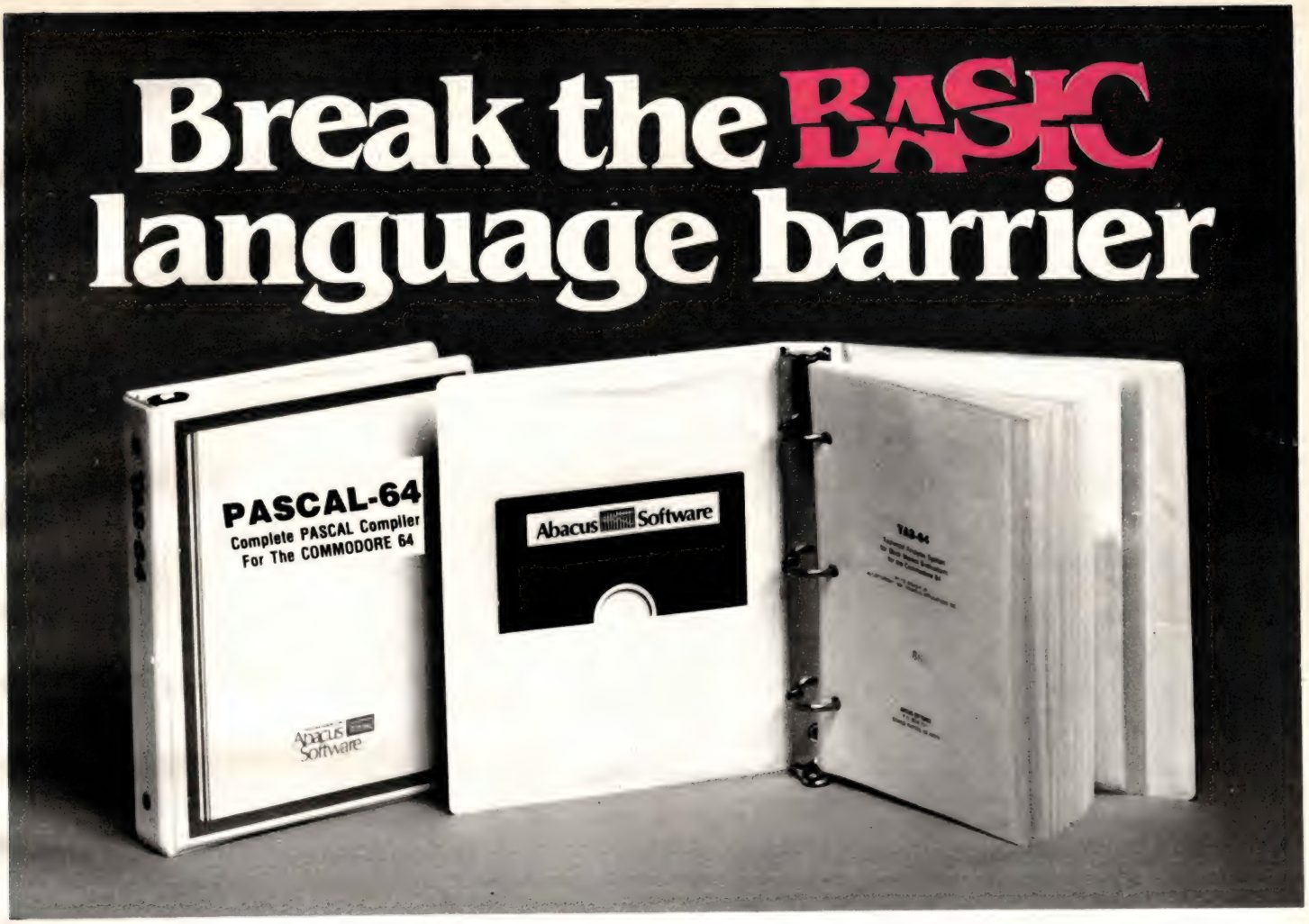
Since you want to change the value you're sending out, select option 1. A screen prompt asks you to press the key you want to redefine; press INST/DEL. Plus/Term tells you that the key currently sends an ASCII 20 and asks you to type in the code you want. Type 127 and press RETURN. The main menu reappears.

It's that easy. Now the INST/DEL key sends an ASCII 127 instead of 20.

Two-Way Translating

You're only half done, though. When Plus/Term sends the 127 over the phone line, the other computer will accept it as a delete key, all right. But then the remote computer echoes the code back to *your* computer (we won't get into the technical reasons). Plus/Term knows that it's supposed to send a 127 instead of a 20, but it doesn't know how to translate the 127 coming back into the 20 that your computer recognizes as a delete key. Instead of deleting characters on your screen, pressing INST/DEL would make back-arrows appear.

Break the BASIC language barrier



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The solution, as you may have guessed, is to customize Plus/Term further so it translates the key in both directions. Select option 6 from the main menu again, then choose option 2 on the submenu (COMING IN). Now you can match the incoming code with the appropriate Commodore code. When the program asks you which code you want to change, type 127. When it asks you for the new value, type 20. Pressing RETURN brings you back to the main menu.

Don't forget that the function keys (except for f7, which calls the main menu) can also be redefined. If you want to save the new definitions so you don't have to repeat the process each time you run Plus/Term, select option 3 from the terminal options menu as described above.

Uploading And Downloading

As we mentioned, one of Plus/Term's most powerful features is the ability to exchange files with other computers.

Downloading is as simple as opening the buffer (CTRL–SHIFT-O in terminal mode), clearing it out if necessary (CTRL–SHIFT-Z), and closing it when you've received everything you want (CTRL–SHIFT-C). Then you can save the buffer on tape or disk by pressing CTRL–SHIFT-S, or print it out from the terminal options menu.

Since the RS-232 routines share zero page locations with the tape input/output routines, tape users must be off-line to perform any type of tape I/O.

To upload a file, reverse the process. Clear the buffer if necessary by pressing CTRL–SHIFT-Z; load the file you wish to transmit by pressing CTRL–SHIFT-L; go to the terminal options menu and select option 6 (PRINT BUFFER); and send the file to the RS-232 port, where your modem is connected.

However, there are some complications—imposed by the computer, not the program. Transferring text files is easy: Usually they're already stored in ASCII format by the word processor, and they can be loaded into another word processor after the transfer is complete. But BASIC program files present a problem.

Most computers, including Commodores, can store programs on tape or disk in two formats: ASCII and *tokenized*. Tokenized files are abbreviated versions of ASCII files. A program must be tokenized before it will run on a VIC or 64. Unfortunately, the VIC and 64 lack a command to load an ASCII file back into the computer and convert it to a tokenized file. After you transfer a program you won't be able to run it.

The Tokenizer Solution

To overcome this limitation, we've included a short tokenizer utility (Program 4) which converts ASCII files to tokenized files. However, it only works if you have a disk drive. Therefore, if you're using a tape drive, you can upload BASIC programs with Plus/Term but not download them in a form your computer can execute.

To convert a tokenized BASIC program file into an ASCII file for uploading, use the following procedure. First, before running Plus/Term, load the program you wish to transfer into the computer. Then type the following and press RETURN:

```
OPEN 8,8,8,"0:FILENAME,P,W":CMD8:LIST [for disk]
OPEN 8,1,8,"0:FILENAME,P,W":CMD8:LIST [for tape]
```

(Replace *FILENAME* with your own filename, of course.)

When the cursor returns, type the following and press RETURN:

```
PRINT#8:CLOSE8
```

The program has now been converted into a Commodore ASCII file which can be uploaded.

Sending A File

Now follow these steps:

1. Run Plus/Term and enter terminal mode.

2. Zero (erase) the buffer (press CTRL–SHIFT-Z).

3. Load your file into the buffer (press CTRL–SHIFT-L). A screen prompt will ask you to enter the filename, and another prompt asks if you want to load from tape or disk.

4. When the disk stops whirring (and the red busy light goes off), close the buffer (press CTRL–SHIFT-C).

5. Establish your communications link with the remote computer (you could have done this during step 1, if desired). Notify the person at the other end of the line that you're ready to send the program file. The other system must be set to receive Commodore ASCII. If the other person has Plus/Term, both of you should adjust your parameters for COMM TO COMM (selection 2 on the terminal options menu described above). The person at the other end should then open and zero his buffer (CTRL–SHIFT-O and CTRL–SHIFT-Z).

6. Now press the f7 key to exit terminal mode and reach the main menu. Select option 7 to call up the terminal options menu. Choose option 6 (PRINT BUFFER) and send the file through the RS-232 port (where your modem is connected). After a while, you'll be asked to press any key to continue. After you press a key, the transfer is complete.

As the file is transmitted, it is listed on the screen of the remote computer. When the word READY appears, the upload is finished. The

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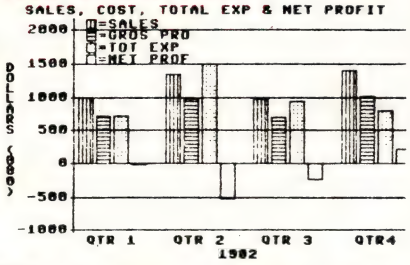

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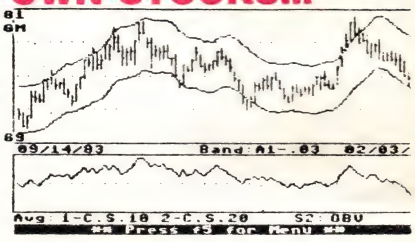

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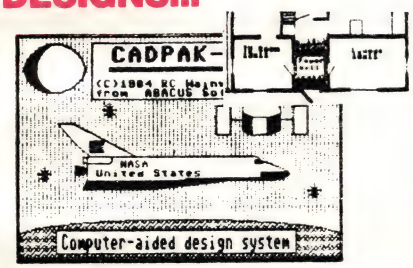

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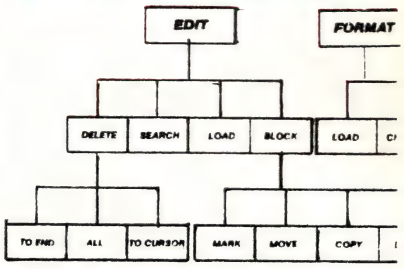

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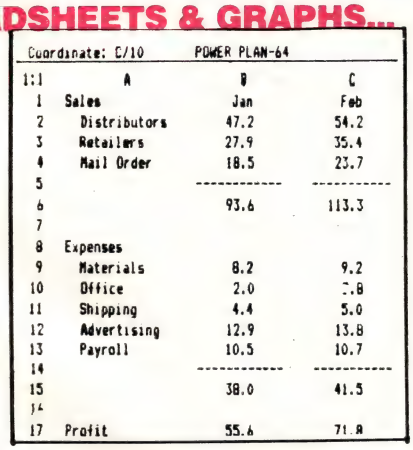

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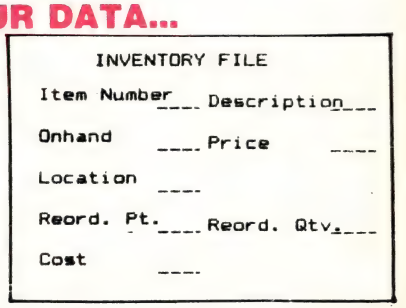

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buffer can then be closed (CTRL–SHIFT-C) and saved on tape or disk (CTRL–SHIFT-S). If the file is a BASIC program, remember to use the Tokenizer utility to convert it from ASCII to a tokenized file before running it.

Using The Tokenizer

Type in Program 4 with MLX. Use a starting address of 828 and ending address of 971.

To use the Tokenizer, load the file produced by MLX into memory. Type NEW, press RETURN, type the following line, and press RETURN:

```
SYS 828,"0:FILENAME"
```

(Substitute the filename for the file you wish to tokenize.)

The file should list on your screen and end with a syntax error. This is normal; ignore the error. If the uploading/downloading process has been successful, you will have a ready-to-run BASIC program in memory that you can save on disk or tape.

80-Column Compatibility

Many mainframe computers expect communications terminals to display 80 columns of text per line, so they format output in that fashion. If you want an 80-column display, Plus/Term is compatible with the "Screen-80" program published in the September 1984 issue of COMPUTE!'s GAZETTE.

There are only a few operating differences in 80-column mode: Word wrap doesn't work, any information on the screen is erased when you leave terminal mode to access the menu, and you must restart the computer to switch back to 40 columns. Otherwise, Plus/Term and Screen-80 make a good team.

Program 1: Plus/Term BASIC Portion For VIC & 64

Refer to "COMPUTE!'s Guide To Typing In Programs" before entering this listing.

```
100 CLOSE2:IF Q=0 THEN Q=1:LOAD"PLUS/TERM
    .ML",8,1                          :rem 127
110 POKE680,1:PRINT"{CLR}";:SYS 65517:IF
    {SPACE}PEEK(781)=22THEN LO=6144:QC=46
    08:GOTO130                        :rem 16
120 LO = 50152:QC=52736               :rem 122
130 FU = 787                          :rem 18
140 NA = 831:RT$="{RVS}"              :rem 148
150 WL$(1)="{RVS}":SB$(1)="{RVS}":PA$(1)=
    "{RVS}":DI$(2)="{RVS}":CA$(2)="{RVS}"
    :FS$(1)="{RVS}"                   :rem 131
160 POKE53281,12:POKE53280,12:PRINT"{CLR}
    {BLK}":POKE646,0:A$=CHR$(13)+"{DOWN}
    {10 RIGHT}"                       :rem 25
170 PRINTCHR$(14);CHR$(8)             :rem 161
180 IF PEEK(185)<>99THENFZ=1:GOTO200
                                      :rem 106
190 SYSLO+6                           :rem 149
200 SYS65517:IF PEEK(781)=22THEN A$=CHR$(
    13)+"{DOWN}":GOTO220              :rem 39
210 A$=CHR$(13)+"{DOWN}{10 RIGHT}"
                                      :rem 141
220 IF FZTHENFZ=0:GOTO540             :rem 11
230 POKE53281,12:POKE53280,12:PRINT"{CLR}
    ";A$;"{2 RIGHT}PARAMETERS"        :rem 59
240 PRINTA$;"1. WORD LENGTH";A$;"2. STOP
    {SPACE}BITS";A$;"3. BAUD RATE";
                                      :rem 94
250 PRINTA$;"4. PARITY";A$;"5. DUPLEX";A$
    ;"6. DEFINE KEY";                 :rem 233
260 PRINTA$;"7. TERMINAL OPTIONS";A$;"8.
    {SPACE}RETURN TO TERMINAL";       :rem 149
270 PRINTA$;"9. RETURN TO BASIC"      :rem 86
280 GET M1$:IF M1$=""THEN 280         :rem 209
290 IF VAL(M1$)<1 OR VAL(M1$)>9 THEN 280
                                      :rem 36
300 ON VAL(M1$) GOTO 310,450,540,710,860,
    970,1230,1760,1800                :rem 152
310 REM WORD LENGTH                   :rem 118
320 PRINT"{CLR}";A$;"{3 RIGHT}{6 DOWN}WOR
    D LENGTH"                         :rem 211
330 PRINTA$;WL$(1);"{2 RIGHT}1. 8 DATA BI
    TS"                               :rem 168
340 PRINTA$;WL$(2);"{2 RIGHT}2. 7 DATA BI
    TS"                               :rem 170
350 PRINTA$;WL$(3);"{2 RIGHT}3. 6 DATA BI
    TS"                               :rem 172
360 PRINTA$;WL$(4);"{2 RIGHT}4. 5 DATA BI
    TS"                               :rem 174
370 POKE198,0                         :rem 199
380 GET MA$:IF MA$=""THEN 380         :rem 243
390 IF MA$=CHR$(13)THEN200            :rem 145
400 FOR T= 1 TO 4:WL$(T)="":NEXT:WL$(VAL(
    MA$))= "{RVS}"                    :rem 127
410 IF VAL(MA$)<1 OR VAL(MA$)>4 THEN 380
                                      :rem 58
420 POKE659,(PEEK(659)AND159)OR(VAL(MA$)*
    16)                               :rem 219
430 POKE198,0                         :rem 196
440 GOTO310                           :rem 101
450 PRINT"{CLR}";A$;"{RIGHT}{11 DOWN}STOP
     BITS ";SB$(1);"1";"{OFF} OR ";SB$(2)
    ;"2";"{OFF}?";                    :rem 247
460 POKE198,0                         :rem 199
470 GET MB$:IF MB$=""THEN470          :rem 245
480 IF MB$=CHR$(13)THEN200            :rem 146
490 FOR T= 1 TO 2:SB$(T)="":NEXT:SB$(VAL(
    MB$))= "{RVS}"                    :rem 107
500 IF VAL(MB$)<1OR VAL(MB$)>2THEN470
                                      :rem 58
510 IF VAL(MB$)=1THENPOKE659,(PEEK(659)AN
    D127):GOTO 530                    :rem 139
520 POKE659,PEEK(659)OR128            :rem 236
530 POKE198,0:GOTO450                 :rem 209
540 PRINT"{CLR}";A$;"{UP}{RIGHT}BAUD RATE
    S";A$;BR$(1);"1. 50 BAUD";        :rem 20
550 PRINTA$;BR$(2);"2. 75 BAUD";A$;BR$(3)
    ;"3. 110 BAUD";                   :rem 73
560 PRINTA$;BR$(4);"4. 134.5 BAUD";A$;BR$
    (5);"5. 150 BAUD";                :rem 229
570 PRINTA$;BR$(6);"6. 300 BAUD";A$;BR$(7
    );"7. 600 BAUD";                  :rem 134
580 PRINTA$;BR$(8);"8. 1200 BAUD";A$;BR$(
    9);"9. 1800 BAUD";                :rem 242
590 PRINTA$;BR$(10);"10. 2400 BAUD";A$;
                                      :rem 0
600 MC$="":INPUT"ENTER SELECTION";MC$
                                      :rem 236
610 IF MC$=""THENMC$=STR$(PEEK(645))
                                      :rem 254
620 IF VAL(MC$)<1OR VAL(MC$)>10THEN540
                                      :rem 108
```

```
630 SYS65517:IFPEEK(781)=22THEN POKE659,(
    PEEK(659)AND240)ORVAL(MC$)    :rem 171
640 TM(1)=50:TM(2)=75:TM(3)=110:TM(4)=134
    .5:TM(5)=150:TM(6)=300:TM(7)=600
                                  :rem 200
650 TM(8)=1225:TM(9)=1800:TM(10)=2400
                                  :rem 199
660 NT=1022730/TM(VAL(MC$))*.5-100:POKE66
    2,NT/256                      :rem 207
670 POKE661,(NT/256-INT(NT/256))*256:POKE
    645,VAL(MC$):CLOSE2           :rem 240
680 OPEN2,2,3,CHR$(PEEK(659))+CHR$(PEEK(6
    60))+CHR$(PEEK(661))+CHR$(PEEK(662))
                                  :rem 7
690 FOR T= 1 TO 10:BR$(T)="":NEXT:BR$(PEE
    K(645))= "{RVS}"              :rem 200
700 GOTO110                       :rem 98
710 PRINT"{CLR}";A$;"{5 DOWN}PARITY";A$;P
    A$(1);"1. NO PARITY";         :rem 234
720 PRINTA$;PA$(2);"2. ODD PAR SNT/RCVD";
                                  :rem 37
730 PRINTA$;PA$(3);"3. EVN PARITY";
                                  :rem 221
740 PRINTA$;PA$(4);"4. MRK PAR SNT/NO CHK
    ";                            :rem 130
750 PRINTA$;PA$(5);"5. SPC PAR SNT/NO CHK
    ";                            :rem 129
760 GET MD$:IF MD$=""THEN 760     :rem 253
770 IF MD$=CHR$(13)THEN200        :rem 150
780 FOR T= 1 TO 5:PA$(T)="":NEXT:PA$(VAL(
    MD$))= "{RVS}"                :rem 106
790 IF VAL(MD$)<1OR VAL(MD$)>5THEN760
                                  :rem 78
800 ON VAL(MD$)GOTO 810,820,830,840
                                  :rem 69
810 POKE660,(PEEK(660)AND31)OR32:GOTO850
                                  :rem 64
820 POKE660,(PEEK(660)AND31)OR96:GOTO850
                                  :rem 75
830 POKE660,(PEEK(660)AND31)OR160:GOTO850
                                  :rem 116
840 POKE660,(PEEK(660)AND31)OR224:rem 102
850 GOTO710                       :rem 110
860 PRINT"{CLR}";A$;"{6 DOWN}{4 RIGHT}DUP
    LEX";A$;                      :rem 168
870 IF PEEK(787)THENDI$(1)="{RVS}":DI$(2)
    ="":GOTO890                   :rem 66
880 DI$(1)="":DI$(2)="{RVS}"      :rem 85
890 PRINT DI$(1);"1. FULL DUPLEX";A$;DI$(
    2)"2. HALF DUPLEX"            :rem 228
900 GET ME$:IF ME$=""THEN900      :rem 247
910 IF ME$=CHR$(13)THEN200        :rem 147
920 FOR T= 1 TO 2:DI$(T)="":NEXT:DI$(VAL(
    ME$))= "{RVS}"                :rem 92
930 IF VAL(ME$)<1OR VAL(ME$)>2THEN900
                                  :rem 69
940 IF VAL(ME$)=1THENPOKE660,PEEK(660)AND
    239:POKEFU,1:GOTO960          :rem 160
950 POKE660,PEEK(660)OR16:POKE FU,0
                                  :rem 15
960 GOTO860                       :rem 118
970 PRINT"{CLR}";A$"{6 DOWN}CHANGE VALUES
    ";A$;                         :rem 159
980 PRINT"1. GOING OUT";A$;"2. COMING IN"
    ;                             :rem 75
990 GET MF$:IF MF$=""THEN990      :rem 11
1000 IF MF$=CHR$(13)THEN200       :rem 187
1010 IF VAL(MF$)<1ORVAL(MF$)>2THEN990
                                  :rem 118
1020 ONVAL(MF$)GOTO 1030,1120     :rem 56
1030 PRINT"{CLR}{8 DOWN}";"PRESS THE KEY
    {SPACE}YOU WANT TO CHANGE":POKE198,0
                                  :rem 109
1040 GET KY$:IF KY$=""THEN1040    :rem 115
1050 KY = PEEK(QC+256+ASC(KY$))   :rem 148
1060 PRINT"{4 DOWN}THAT SENDS A CHR$(";
                                  :rem 47
1070 PRINTRIGHT$(STR$(KY),LEN(STR$(KY))-1
    )+")"                         :rem 190
1080 INPUT"{4 DOWN}REPLACE WITH";RK$
                                  :rem 21
1090 IF VAL(RK$)>255THEN 1030     :rem 27
1100 POKEQC+256+ASC(KY$),VAL(RK$):rem 137
1110 GOTO 200                     :rem 142
1120 INPUT"{CLR}{8 DOWN}CODE TO CHANGE";I
    C$                            :rem 2
1130 IF IC$=""THEN970             :rem 84
1140 IF VAL(IC$)>255ORVAL(IC$)=0 THEN 112
    0                             :rem 248
1150 PRINT"{4 DOWN}NOW A CHR$(";  :rem 117
1160 IC = PEEK(QC+VAL(IC$))       :rem 170
1170 PRINTRIGHT$(STR$(IC),LEN(STR$(IC))-1
    )+")"                         :rem 143
1180 INPUT "{4 DOWN}CHANGE TO CHR$";NK$
                                  :rem 36
1190 IF NK$=""THEN970             :rem 103
1200 IF VAL(NK$)>255THEN 1120     :rem 16
1210 POKE QC+VAL(IC$),VAL(NK$)    :rem 179
1220 GOTO200                      :rem 144
1230 PRINT "{CLR}";A$;"{4 DOWN}{4 RIGHT}O
    PTIONS";A$;"1. DIRECTORY (DISK)";
                                  :rem 23
1240 PRINTA$;CA$(1);"2. COMM TO COMM";
                                  :rem 51
1250 PRINTA$;CA$(2);"3. COMM TO ASCII";
                                  :rem 115
1260 PRINTA$;FS$(1);"4. WORD WRAP";
                                  :rem 199
1270 PRINTA$;FS$(2);"5. NORMAL SCREEN";
                                  :rem 221
1280 PRINTA$;"6. PRINT BUFFER";   :rem 34
1290? PRINTA$;RT$;"7. LINEFEED W/ RETURN"
                                  :rem 73
1300 GET OP$:IF OP$=""THEN 1300   :rem 103
1310 IF OP$=CHR$(13)THEN200       :rem 203
1320 IF VAL(OP$)=2THENCA$(1)="{RVS}":CA$(
    2)=""                         :rem 141
1330 IF VAL(OP$)=3THENCA$(2)="{RVS}":CA$(
    1)=""                         :rem 143
1340 IF VAL(OP$)=4THENFS$(1)="{RVS}":FS$(
    2)=""                         :rem 187
1350 IF VAL(OP$)=5THENFS$(2)="{RVS}":FS$(
    1)=""                         :rem 189
1360 IF VAL(OP$)=7 THEN POKE 680,-(PEEK(6
    80)=0)                        :rem 235
1370 IF PEEK(680)THENRT$="{RVS}":GOTO1390
                                  :rem 58
1380 RT$=""                       :rem 23
1390 IF VAL(OP$)<1OR VAL(OP$)>7THEN1300
                                  :rem 192
1400 ON VAL(OP$)GOTO 1410,1540,1550,1780,
    1790,1810,1230                :rem 38
1410 PRINT"{CLR}":OPEN1,8,0,"$0"  :rem 75
1420 GET #1,T$,T$                 :rem 67
1430 GET #1,T$,T$                 :rem 68
1440 S=ST:IF S<>0 THENCLOSE1:GOTO 1500
                                  :rem 213
1450 GET #1,LU$,HI$:              :rem 10
1460 LU=ASC(LU$+CHR$(0)):HI=ASC(HI$+CHR$(
    0)):LN=LU+HI*256:LN$=MID$(STR$(LN),2
    )                             :rem 244
```

```
1470 PRINTLN$+" ";                    :rem 193
1480 GET#1,B$:IF B$="" THEN PRINT:GOTO143
     Ø                                :rem 58
1490 PRINTB$;:GOTO148Ø                :rem 60
1500 OPEN15,8,15:INPUT#15,EN,EM$,ET,ES:CL
     OSE15:IF ENTHENPRINTEN;EM$;ET;ES
                                      :rem 42
1510 PRINT"{RVS}PRESS RETURN TO CONTINUE
     {OFF}"                           :rem 177
1520 GET T$:IF T$<>CHR$(13)THEN1520
                                      :rem 136
1530 GOTO123Ø                         :rem 200
1540 POKE NA,1:GOTO123Ø               :rem 30
1550 POKENA,Ø                         :rem 229
1560 PRINT"{CLR}{6 DOWN}";A$;"ASCII OPTIO
     NS";A$;"1. LOAD CONFIG";         :rem 217
1570 PRINTA$;"2. SAVE CONFIG";A$;     :rem 94
1580 PRINT"3. RETURN TO MENU"         :rem 184
1590 GET CN$:IF CN$=""THEN1590        :rem 97
1600 IF VAL(CN$)<1ORVAL(CN$)>3THEN1590
                                      :rem 165
1610 ON VAL(CN$)GOTO162Ø,163Ø,164Ø:rem 61
1620 GOSUB 165Ø:SYS PEEK(764)+256*PEEK(76
     5):GOSUB174Ø:GOTO123Ø            :rem 46
1630 GOSUB 165Ø:SYS PEEK(766)+256*PEEK(76
     7):GOSUB174Ø:GOTO123Ø            :rem 51
1640 GOTO123Ø                         :rem 202
1650 PRINT"{CLR}";A$;"{RVS}D{OFF}ISK OR
     {RVS}T{OFF}APE";A$;              :rem 104
1660 GET DV$:IF DV$<>"T"ANDDV$<>"D"THEN16
     6Ø                               :rem 147
1670 INPUT"FILENAME";FI$              :rem 209
1680 IF LEN(FI$)>16THEN 167Ø          :rem 227
1690 IF LEFT$(DV$,1)="D"THEN D=8:GOTO 171
     Ø                                 :rem 3
1700 D=1                              :rem 122
1710 FOR T= 684 TO 684+LEN(FI$)-1:POKET,A
     SC(MID$(FI$,T-683,1)):NEXT       :rem 203
1720 POKE679,D:POKE763,D:POKE681,LEN(FI$)
     :POKE682,172:POKE683,2           :rem 214
1730 RETURN                           :rem 171
1740 OPEN15,8,15:INPUT#15,EN,EM$,ET,ES:CL
     OSE15:PRINT:IFENTHENPRINTEN;EM$;ET;E
     S                                :rem 247
1750 FOR T=1 TO 15ØØ:NEXT:RETURN      :rem 114
1760 PRINT"{CLR}":SYSLO                 :rem 6
1770 GOTO2ØØ                          :rem 154
1780 POKE7Ø3,Ø:GOTO123Ø                :rem 46
1790 POKE7Ø3,1:GOTO123Ø                :rem 48
1800 END                              :rem 160
1810 BY=PEEK(7Ø6)+256*PEEK(7Ø7)-(PEEK(55)
     +256*PEEK(56)):PRINT"{CLR}{DOWN}";A$
     ;BY;                             :rem 76
1820 PRINT"BYTES IN BUFFER";A$;:PRINT" TO
     TAL BYTES";                      :rem 160
1830 PRINT(PEEK(249)+256*PEEK(25Ø))-(PEEK
     (55)+256*PEEK(56))               :rem 239
1840 PRINTA$;"PRINT TO"               :rem 110
1850 PRINTA$;"1. RETURN";A$;"2. RS232 ";A
     $;"3. SCREEN";A$;"4. PRINTER";
                                      :rem 89
1860 GET ZE$:ZE=VAL(ZE$):IF ZE<1OR ZE>4 T
     HEN 1860                          :rem 4
1870 PRINT"{CLR}":IF ZE=1 THEN1230
                                      :rem 255
1880 IF ZE=2 THEN 191Ø                :rem 104
1890 IF BY=ØTHEN199Ø                  :rem 107
1900 OPEN5,ZE                         :rem 252
1910 FOR T = PEEK(55)+256*PEEK(56)TO(PEEK
     (7Ø6)+256*PEEK(7Ø7))-1:POKE212,Ø
                                      :rem 187
1920 IF PEEK(653)=1 THEN192Ø          :rem 216
1930 IF PEEK(197)=6ØTHENFORT=ØTOØ:rem 192
1940 IF PEEK(653)=4 THEN FOR J= 1 TO 1ØØØ
     :NEXT                            :rem 141
1950 IF ZE = 2 THENPRINT#2,CHR$(PEEK(T));
     :GOTO197Ø                        :rem 68
1960 PRINT#5,CHR$(PEEK(T));           :rem 56
1970 NEXT                             :rem 16
1980 IF ZE<>2 THEN PRINT#5:CLOSE 5
                                      :rem 165
1990 POKE198,Ø:PRINTA$;"PRESS ANY KEY TO
     {SPACE}CONT"                     :rem 224
2ØØØ GET J$:IF J$=""THEN2ØØØ          :rem 185
2Ø1Ø GOTO 123Ø                        :rem 194
```

Program 2: Plus/Term ML Portion For 64

Refer to the "MLX" article before entering this listing.

```
50152 :Ø32,Ø75,2Ø4,Ø76,251,196,Ø42
50158 :169,ØØØ,141,1ØØ,196,141,217
50164 :1Ø3,196,141,Ø84,2Ø5,133,Ø82
50170 :ØØ2,141,191,ØØ2,141,Ø63,Ø22
50176 :ØØ3,169,231,141,252,ØØ2,Ø3Ø
50182 :169,2Ø4,141,253,ØØ2,169,176
50188 :ØØ8,141,254,ØØ2,169,2Ø5,Ø23
50194 :141,255,ØØ2,169,ØØ1,141,215
50200 :Ø21,2Ø8,169,ØØ6,141,Ø33,Ø9Ø
50206 :2Ø8,173,Ø38,ØØ3,2Ø1,21Ø,Ø95
50212 :2Ø8,Ø15,173,Ø39,ØØ3,2Ø1,163
50218 :ØØ2,2Ø8,ØØ8,169,ØØ1,141,Ø59
50224 :Ø94,2Ø5,Ø76,127,196,169,147
50230 :ØØØ,141,Ø94,2Ø5,169,ØØ4,155
50236 :141,136,ØØ2,169,Ø23,141,16Ø
50242 :Ø24,2Ø8,169,ØØ3,Ø13,ØØ2,229
50248 :221,141,ØØ2,221,169,ØØ3,Ø61
50254 :Ø13,ØØØ,221,141,ØØØ,221,162
50260 :12Ø,169,Ø51,133,ØØ1,169,215
50266 :2Ø8,141,1Ø1,196,141,1Ø4,213
50272 :196,16Ø,ØØØ,185,255,255,123
50278 :153,255,255,2ØØ,2Ø8,247,14Ø
50284 :238,1Ø1,196,238,1Ø4,196,157
50290 :173,1Ø4,196,2Ø1,224,2Ø8,196
50296 :234,169,Ø55,133,ØØ1,Ø88,Ø32
50302 :152,162,Ø64,157,Ø64,ØØ3,216
50308 :2Ø2,Ø16,25Ø,169,255,141,141
50314 :Ø85,ØØ3,169,Ø13,141,248,Ø29
50320 :ØØ7,Ø32,168,196,169,ØØØ,2Ø4
50326 :141,194,ØØ2,133,Ø55,141,Ø48
50332 :Ø19,ØØ3,169,Ø38,133,Ø56,Ø62
50338 :141,195,ØØ2,Ø76,ØØ8,197,Ø13
50344 :16Ø,255,152,192,219,176,Ø42
50350 :Ø24,192,193,144,ØØ6,Ø56,Ø21
50356 :233,128,Ø76,2Ø1,196,192,182
50362 :Ø65,144,Ø12,192,Ø96,176,1Ø3
50368 :ØØ6,Ø24,1Ø5,Ø32,Ø76,2Ø1,124
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50380 :136,192,255,2Ø8,217,16Ø,Ø92
50386 :255,152,192,128,176,Ø24,113
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50398 :Ø32,Ø76,242,196,192,Ø65,ØØ1
50404 :144,Ø12,192,Ø91,176,ØØ8,Ø83
50410 :Ø24,1Ø5,128,Ø76,242,196,237
50416 :169,ØØØ,153,ØØØ,2Ø6,136,136
50422 :192,255,2Ø8,217,Ø96,174,1Ø8
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50434 :141,Ø85,2Ø5,Ø32,248,2Ø1,146
50440 :Ø32,Ø48,2ØØ,Ø32,2Ø4,255,Ø11
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50512 :141,194,002,165,056,141,011
50518 :195,002,032,066,198,076,143
50524 :202,197,201,019,208,006,157
50530 :032,124,198,076,202,197,159
50536 :201,012,208,006,032,185,236
50542 :199,076,202,197,201,002,219
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50554 :202,197,201,011,208,006,179
50560 :238,134,002,076,202,197,209
50566 :201,006,208,006,238,032,057
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50578 :208,011,173,024,208,073,075
50584 :002,141,024,208,076,202,037
50590 :197,162,002,032,201,255,239
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50650 :208,003,076,008,197,174,116
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50956 :205,140,100,205,032,248,174
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51190 :085,076,076,093,013,013,090
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51220 :013,084,065,080,069,032,107
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51346 :141,016,208,173,055,205,176
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51358 :024,173,086,205,105,050,033
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51370 :014,144,013,133,162,173,041
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51382 :208,076,192,200,173,134,141
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51454 :210,136,232,224,039,240,055
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51508 :205,174,053,205,168,202,035
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51616 :205,165,250,237,195,002,190
51622 :013,088,205,208,021,162,095
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51658 :238,195,002,076,248,201,138
51664 :141,085,205,173,194,002,240
51670 :229,055,141,088,205,173,081
51676 :195,002,229,056,013,088,035
51682 :205,240,019,072,056,173,223
51688 :194,002,233,001,141,194,229

51694 :002,173,195,002,233,000,075
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51706 :205,174,094,205,240,072,216

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51742 :164,032,068,168,032,125,107
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51754 :104,174,102,205,134,251,244
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51766 :210,002,166,251,142,102,159
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51802 :032,065,203,172,055,205,054
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51856 :233,212,133,210,173,054,135
51862 :205,201,039,208,008,174,217
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51886 :032,176,074,201,010,208,107
51892 :003,238,055,205,201,013,127
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51976 :072,173,024,208,041,253,011
51982 :141,024,208,104,201,145,069
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52054 :055,205,185,240,236,133,116
52060 :209,185,056,205,133,210,066
52066 :172,054,205,240,051,056,108
52072 :169,039,237,054,205,170,210
52078 :177,209,136,145,209,200,162
52084 :024,165,210,105,212,133,197
52090 :210,177,209,136,145,209,184
52096 :056,165,210,233,212,133,113
52102 :210,200,200,202,224,255,145
52108 :208,224,169,032,160,039,204
52114 :145,209,206,054,205,032,229
52120 :048,200,096,174,168,002,072
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52156 :205,172,055,205,140,089,030
52162 :205,162,002,032,201,255,027
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52174 :204,255,169,216,141,229,140
52180 :203,169,000,141,228,203,132
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52192 :141,232,203,185,255,255,215
52198 :153,255,255,056,173,228,070
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52258 :041,015,141,024,208,173,124
52264 :033,208,141,091,205,173,123
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Program 3: Plus/Term ML Portion For VIC

Refer to the "MLX" article before entering this listing.

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6918 :222,172,104,033,153,050,228
6924 :033,238,104,033,141,093,142
6930 :033,032,252,029,172,104,128
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7182 :084,065,080,069,032,079,167
7188 :082,032,068,073,083,075,177
7194 :013,013,070,073,076,069,084
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7236 :032,076,085,028,238,214,229
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7248 :169,021,141,214,032,173,062
7254 :215,032,048,013,201,023,106
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7284 :032,133,210,096,172,214,205
7290 :032,177,209,073,128,145,118
7296 :209,024,165,210,105,132,205
7302 :133,210,165,209,105,000,188
7308 :133,209,173,102,033,240,006
7314 :022,177,209,041,015,141,239
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7452 :173,215,032,201,023,208,112
7458 :006,032,117,233,206,215,075
7464 :032,238,215,032,169,000,214
7470 :141,214,032,032,052,028,033
7476 :174,213,032,160,000,202,065
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7650 :229,056,013,096,033,240,125
7656 :019,072,056,173,194,002,236
7662 :233,001,141,194,002,173,214
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7722 :090,033,009,128,145,209,144
7728 :076,056,030,173,090,033,250
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7740 :132,133,210,173,134,002,076
7746 :145,209,056,165,210,233,060
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7788 :238,214,032,032,052,028,192
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7824 :013,005,144,141,005,144,084
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7854 :201,019,208,013,072,169,088
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7968 :028,104,032,052,028,032,052
7974 :120,028,096,173,093,033,069
7980 :041,128,074,141,095,033,044
7986 :173,093,033,041,063,013,210
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7998 :172,215,032,185,240,032,170
8004 :133,209,185,216,032,133,208
8010 :210,172,214,032,240,051,225
8016 :056,169,021,237,214,032,041
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8034 :133,210,177,209,136,145,084
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8058 :021,145,209,206,214,032,181
8064 :032,052,028,096,174,168,166
8070 :002,240,003,238,215,032,096
8076 :169,000,141,214,032,141,069
8082 :091,033,032,052,028,096,222
8088 :174,214,032,142,098,033,077
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8100 :162,002,032,201,255,169,217
8106 :019,032,210,255,032,204,154
8112 :255,169,148,141,199,031,095
8118 :169,000,141,198,031,141,094
8124 :201,031,169,022,141,202,186
8130 :031,160,000,185,255,255,056
8136 :153,255,255,056,173,201,013
8142 :031,233,250,141,096,033,222
8148 :173,202,031,233,023,013,119
8154 :096,033,240,017,238,198,016
8160 :031,238,201,031,208,223,132
8166 :238,199,031,238,202,031,145
8172 :076,197,031,169,020,141,102
8178 :136,002,173,015,144,141,085
8184 :099,033,169,210,141,005,137
8190 :144,173,134,002,141,100,180
8196 :033,160,025,185,217,000,112
8202 :153,000,034,185,050,034,210
```

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8208 :153,217,000,136,016,241,011
8214 :096,169,022,141,060,032,030
8220 :169,000,141,059,032,162,079
8226 :002,032,201,255,169,017,198
8232 :032,210,255,032,204,255,004
8238 :169,000,141,062,032,169,107
8244 :148,141,063,032,160,000,084
8250 :185,255,255,153,255,255,136
8256 :056,173,059,032,233,250,099
8262 :141,096,033,173,060,032,093
8268 :233,023,013,096,033,240,202
8274 :017,238,059,032,238,062,216
8280 :032,208,223,238,060,032,113
8286 :238,063,032,076,058,032,081
8292 :173,099,033,141,015,144,193
8298 :173,100,033,141,134,002,177
8304 :169,016,141,136,002,169,233
8310 :194,141,005,144,160,025,019
8316 :185,217,000,153,050,034,251
8322 :185,000,034,153,217,000,207
8328 :136,016,241,096,173,167,197
8334 :002,174,251,002,160,001,220
8340 :032,186,255,173,169,002,197
8346 :162,172,160,002,032,189,103
8352 :255,169,000,162,000,160,138
8358 :024,032,213,255,096,173,191
8364 :167,002,174,251,002,160,160
8370 :001,032,186,255,173,169,226
8376 :002,162,172,160,002,032,202
8382 :189,255,169,024,133,254,190
8388 :169,000,133,253,169,253,149
8394 :162,255,160,025,032,216,028
8400 :255,096,000,000,000,000,047
8406 :000,000,016,016,016,016,022
8412 :016,016,016,016,016,016,060
8418 :016,016,017,017,017,017,070
8424 :017,017,017,017,017,017,078
8430 :017,017,000,022,044,066,148
8436 :088,110,132,154,176,198,078
8442 :220,242,008,030,052,074,108
8448 :096,118,140,162,184,206,138
8454 :228,250,013,013,013,013,024
```

Program 4: VIC/64 Tokenizer (Disk Only)

Refer to the "MLX" article before entering this listing.

```
828 :032,237,255,224,022,240,046
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852 :205,032,130,215,166,034,098
858 :164,035,032,189,255,166,163
864 :034,164,035,032,189,255,037
870 :169,032,162,008,160,008,129
876 :032,186,255,032,192,255,036
882 :169,125,141,036,003,169,245
888 :003,141,037,003,096,008,152
894 :138,072,152,072,169,008,225
900 :032,180,255,169,104,032,136
906 :150,255,032,165,255,141,112
912 :203,003,032,171,255,165,205
918 :144,240,026,169,032,032,025
924 :195,255,032,138,255,169,176
930 :008,032,177,255,169,232,011
936 :032,147,255,032,174,255,039
942 :169,013,141,203,003,173,108
948 :204,003,208,010,173,203,213
954 :003,201,013,240,003,032,166
960 :210,255,104,168,104,170,179
966 :040,173,203,003,096,000,201
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THE BEGINNER'S PAGE

Tom R. Halfhill, Editor

IF-THEN Intelligence

At one time or another you've probably seen the term *artificial intelligence.* It refers, of course, to computer intelligence—the ability of a machine to reproduce (or, if you prefer, simulate) some of the thought processes of a human being.

We're not going to reopen here the philosophical debate about whether computers are really intelligent, or if they ever will be intelligent (or for that matter, if humans are intelligent). Scientists still can't agree on exactly how the human brain works, much less whether it can be duplicated in silicon circuitry.

But we do know how computers work. Although computers aren't (yet) capable of independent thought or action, they certainly appear intelligent at times. They can play chess at the grandmaster level, forecast tomorrow's weather as well as anybody else, help plan the economy of a household or a nation, create wonderfully abstract art, and even simulate the responses of a psychoanalyst closely enough to fool many laypeople. How can a mass of wires and silicon chips seem to be so smart? What sets computers apart from all other machines?

Programmability alone isn't the answer. There were programmable machines long before computers came along. One example is the centuries-old music box. A melody is programmed into the box by punching little bumps onto the surface of a revolving drum; as the drum turns, the bumps pluck a series of tiny metal prongs tuned to different notes. Of course, a music box is capable of playing only one melody drum, or "program." A more sophisticated example is the player piano, with its interchangeable paper rolls that operate on the same principle.

Still, there's something missing from a programmable player piano that keeps it from qualifying as a true computer. Even some of today's programmable calculators lack the essential element of computer intelligence. They, too, can be programmed to carry out a series of steps, but they can't imitate the decision-making power of a real brain.

What do computers have that all these other machines don't? *Conditional logic.* Although some other devices are capable of conditional logic on a very primitive level, no machine can do it as flexibly as a computer.

Michael Jackson Vs. Beethoven

Here's how conditional logic works. Let's say you send a friend to a record store with a $10 bill and these instructions: "If the store has Michael Jackson's latest album, then buy it for me. Otherwise, buy the Cleveland Symphony Orchestra's new recording of Beethoven's Fifth."

Now, you've done more than simply programmed your friend to visit the store and buy you a record. You've given him the power to make a decision in your absence, and also the information he needs to make the decision. Depending on whether a certain *condition* is met (if the store has Michael Jackson's latest album or not), your friend will act on either of the two alternatives (he'll buy you the Jackson record or the Beethoven record). Even if your friend has the brains of a hamster, he'll appear semi-intelligent to the record store clerk as he flips through the bins and picks the correct album.

All computer programming languages have commands that let you tell the computer to make the same sort of decisions. In BASIC, the most common command for conditional logic is the IF-THEN statement. It takes this form:

IF *condition is met* **THEN** *perform this action.*

Computers don't understand English, of course, so the italicized words above must be replaced with terms the computer *can* understand. Usually the conditional part of the statement involves a comparison between variables and numbers. And often the resulting action will be a second command which sends the computer to another section of the program. Let's try some actual examples.

Conversational Computing

At one time or another you've probably used a computer program which carries on a conversation with you, depending on how you respond to certain questions. The machine appears almost human, and conditional logic is the key.

Let's say you're an insurance salesman who is writing a program designed to analyze a client's

life insurance needs. One of the first questions the program needs to ask is the person's age. This can be done with a simple PRINT statement. Clear the computer's memory by turning it off, then on again, and type the following line exactly as it appears (remember that to enter a program line into memory, you must press the RETURN or ENTER key after typing the line):

```
10 PRINT "What is your age";
```

When the program runs, the PRINT statement will print the text between the quotes on the screen. Next, type this line:

```
20 INPUT A
```

When the program runs, this simple statement does three things. First, it prints a question mark after the text in the PRINT statement. Second, it makes the computer pause until someone types in a number on the keyboard. Finally, it takes the number and stores it in a memory location which can be referenced with the variable name A.

Now it's time for some conditional logic. Enter these two lines:

```
30 IF A>100 THEN PRINT "It's a little late to be
thinking about life insurance, isn't it?":END
40 PRINT "We have just the policy that you need."
```

Now clear the screen and run the program. When it asks for your age, try typing in a number less than 100. Then run the program again and type in a number greater than 100. See the difference? (Note: This program requires Extended BASIC on the TI-99/4A.)

Here's how it works. Line 30 compares the value stored in the variable A with 100. If A is greater than 100 (> is the *greater-than* sign), then the condition is met and the computer performs the instruction which immediately follows. *The second half of an IF-THEN statement is executed only when the condition in the first half is true.* (Incidentally, line 30 is also a *multistatement line;* a colon separates the second statement, END, from the IF-THEN statement. This command ends the program after the remark is printed.)

If the user claims to be less than 100 years old, the condition in line 30 is not met. Therefore, the computer ignores the rest of line 30 and continues (or "falls through") to the next line. The computer prints a different message on the screen and, presumably, would go on to the remainder of the program.

Simulated Intelligence

Although this simple four-line program contains only one conditional statement, it illustrates how computers can appear intelligent. The computer not only makes different responses depending on the user's input, it also seems to know that centenarians are unlikely candidates for life insurance. It even reveals a snappy sense of humor. Of course, it's really the programmer talking, not the computer. (Remember this the next time your computer makes a rude remark.)

Simple conditional statements like the one above are the basis for nearly all of what passes as artificial intelligence today. All programs work on the same principle, from the sophisticated modeling software that forecasts the nation's economy to the chess program which threatens the supremacy of the world's top champions. In fact, the chess program published in the December 1984 issue of COMPUTE!, when playing on level 5, uses a similar technique to evaluate up to 50 million possible moves during each turn. Naturally, a program that complicated must be written in machine language, not BASIC, or you'd be waiting months for the computer's response.

The IF-THEN statement isn't the only way to simulate intelligence in BASIC. Most BASICs have at least two other statements which accomplish more or less the same thing. This indicates how important conditional logic really is in programming. (Linguists say you can determine a language's most often used concepts by counting the synonyms—interestingly, somebody once figured out that English has more terms for being inebriated than almost any other concept.)

In BASIC, as we mentioned, IF-THEN is by far the most common conditional statement. Some of the more powerful BASICs—such as IBM BASIC—augment the IF-THEN statement with an ELSE condition. This lets you combine two lines into one. For instance, lines 30 and 40 above could be rewritten like this in IBM BASIC:

```
30 IF A<100 THEN PRINT "We have just the policy
for your needs." ELSE PRINT "It's a little late to be
thinking about life insurance, isn't it?":END
```

ELSE doesn't let you do anything you couldn't do otherwise; it just makes programming more convenient.

Other examples of conditional statements in BASIC are ON-GOTO and ON-GOSUB. In effect, these let you combine a whole series of IF-THENs into one compact line. They are also called *conditional branching* statements because they branch to other parts of the program. An IF-THEN statement can be used for conditional branching, too. We'll cover both conditional and unconditional branching in next month's column, and also show a couple of ways to avoid long, cumbersome lists of IF-THENs in your programs.

Questions Beginners Ask

Q What exactly is a *crash* or a *freeze* and how can I avoid it? All I know so far is

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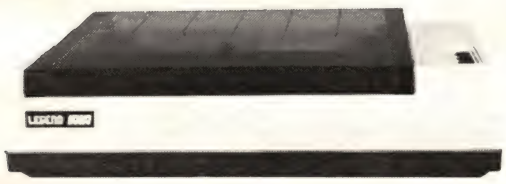

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that it can happen when one mistypes numbers in DATA statements, but not why, nor what else can cause it, so I can't yet reason backward from crash to cause. I've been trying to translate a budget and cash-flow analysis program written for the IBM PC so it will run on a Timex Sinclair TS-1000 with a 16K RAM pack, which in theory should take a program up to 900 lines long. But I can't even begin to type it in. The first 30 lines contain a DIM block of about ten lines and other statements. Before I can finish, I get a crash: blank screen, no cursor, keyboard dead, BREAK and STOP keys disabled. Nothing to do but unplug, replug, and start from scratch. Nothing here seems similar to mistyping figures in DATA statements, and I don't see how I could be running out of memory so soon (the manual says you will eventually—not bang all of a sudden—reach a blank screen when you've jammed the poor beast beyond capacity).

Norman Hartweg

A You've described the symptoms of a *system crash* or *freeze* perfectly—the screen often goes haywire, the computer won't respond to commands typed on the keyboard, and your only alternative is to power down and wipe out whatever you were working on.

Disregarding rare hardware failures, system crashes generally happen when the computer gets stuck in what's called an *infinite loop* at the machine level. This means the computer tries to execute a series of instructions which loop back on themselves or cancel each other out. The computer might look paralyzed, but it's really very busy trying to accomplish the impossible. So busy, in fact, that it ignores everything else, including your demands for attention on the keyboard.

As an example, suppose you told somebody to resolve these two statements: "Assume everything I say is always the truth. Now, I'm telling a lie." If everything you say is the truth, then you're telling the truth when you say you're lying. But if you're really lying, then everything you say isn't always the truth. But it's a given that you never tell a lie . . . and so on. You can go back and forth like this forever—except you're smart enough not to try, and a computer isn't. (*Star Trek* fans may recall how Captain Kirk used this classic paradox to provoke an android into a system crash and free his crew.)

System crashes can happen when DATA statements are mistyped, because DATA numbers often contain machine language subprograms. A mistyped number can create a wrong instruction, which in turn can trap the computer in an endless loop. Typing the wrong number in a POKE statement can do the same thing.

However, these crashes happen only when the program runs, not when it's being typed. As you surmised, your symptoms indicate a memory problem. Check these possibilities:

1. The 16K RAM pack on a TS-1000 fits rather loosely. If it's not plugged in all the way, the computer may not be recognizing the extra memory, leaving you with only the 2K internal RAM, not the 16K you think you have. Also, if the pack wiggles when you type on the keyboard, the faulty connection can crash the computer.

2. The DIM statements you mentioned at the beginning of the program may be eating up all your RAM. DIM statements aren't like other statements; they take up more memory than just the characters they're composed of. The purpose of a DIM statement is to reserve a block of memory for an array (a series of related variables). In Sinclair BASIC, each element of a numeric array consumes five bytes each. The statement **DIM X(375)** might look pretty short and harmless, but it actually consumes so much memory that it causes an error when typed into a TS-1000 with 2K of RAM. If the DIM statements are the source of your trouble, you'll have to scale down the IBM program to fit it into your Timex. ©

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Adding Sound Effects To Atari

Matt Giwer

Do you want more realistic sounds than beeps? This article gives you five short programs that let your Atari produce some interesting, subtle sounds.

There are many packages available for making the Atari a music box. All provide some degree of musical verisimilitude; that is, they sound good. However, these packages don't really help those who are tired of hearing the same old beeps in their programs.

Let's consider how tones are generated in the real world and try to duplicate them on the computer. And take heart: It will all be done in BASIC. You won't even find a page 6 subroutine. You can improve on what I have done once you understand what is going on.

Frequencies And Amplitude

Sound is generated by vibrating objects. Each object sounds different because it has a different set of resonant frequencies. Also, each object has a different set of loss parameters that determine how quickly the amplitude of the sound will rise and fall. Other factors such as the noise content add to the character of each individual sound.

The resonant frequency of an object is the dominant characteristic, so let's take it first. Strike a bell or play a note on a piano and you don't hear just one frequency, you hear a wide range of frequencies. The lowest frequency is called the fundamental frequency. Most objects also support harmonics of this frequency. The even harmonics are two, four, six, eight, and so forth times as high as the fundamental. The odd harmonics are three, five, seven, nine, and so forth times as high.

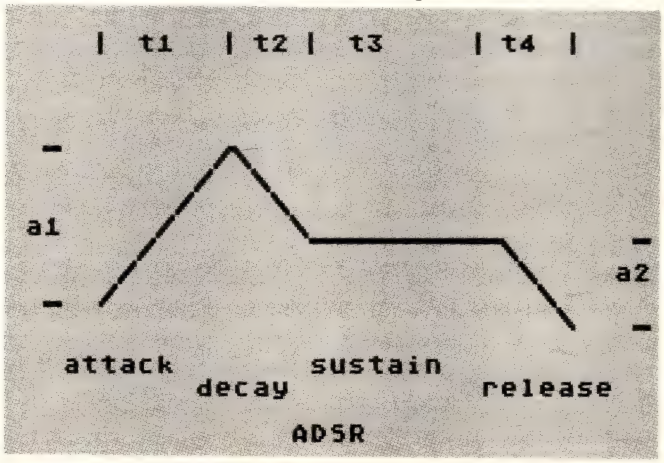
The mix of these frequencies and whether they are odd or even are components of the character of the sound. A piano is rich in even harmonics; a woodwind is rich in odd harmonics. There is one further complication: Most objects have more than one fundamental frequency, and each fundamental frequency may have its own set of harmonics. It is thus obvious why simple beeps lack the complexity of real sounds.

The next factor is how fast the amplitude of these frequencies rises and falls. When a drum is struck, it gives a short, loud sound, so its amplitude rises and falls quickly. A piano note is loud, but is sustained for some time. A woodwind rises slowly in amplitude and falls slowly.

The simplification used for electronic simulation of musical instruments is called the ADSR envelope (shown in the figure). These letters stand for Attack, Decay, Sustain, and Release. Across the top are times 1 through 4 and amplitudes 1 and 2. A struck instrument has a very short t1 and a somewhat longer t2. For a piano, t3 and t4 are relatively long and for a drum, t3 and t4 are short. Also for struck instruments the amplitude a1 will be at least twice as great as a2, but in a woodwind they may be the same.

Noise And Tone

The third factor is the amount of noise. This is easily heard in a snare drum, which contains added wires to make noise. It is less obvious in woodwinds, where the very act of blowing creates some noise. Blowing is similar to whispering, where there is little tonal content and the lips and tongue are modulating noise. A



"breathy" speech pattern is comparable to a horn or woodwind. Thus a low amplitude component of noise can add to the realism.

With these three factors in mind, let's examine a woodwind in detail. The artist is aware that the instrument has a slow attack time, so he will blow harder at the beginning of a note to give it a definite start. In doing so he will increase the noise level. The initial breath will start the instrument vibrating, and the various fundamentals and harmonics will be heard. If the instrument is being played loudly, some of the harder-to-excite frequencies will be heard too.

Once the instrument has established its note, the artist will blow more softly, so the tone content will be up, but the noise component will be down. Finally the note will end, and the artist will stop blowing. The noise component will stop immediately, but the tonal component will continue for a short time. If all this doesn't sound complex enough, imagine what goes on in a slide trombone.

Real sounds are complex, but computer-generated tones are not. So we must make them complex to make them realistic. For a perfect simulation of a piano or clarinet, a Moog synthesizer is definitely preferred. To make do with the Atari sound chip, machine language might be preferable. But if you draw a line with one end being the beeps and the other end the Moog, we'll see that BASIC *can* get us more than halfway toward the Moog.

Experimenting With Sound Qualities

The following programs are examples of some complex sonic effects. These programs directly POKE the audio control registers with amplitude information. The amplitude varies from 0 (off) to 15 (loudest). These amplitude levels are stored in S0$ in pairs of numbers. These are converted to numbers in line 21 and POKEd in line 22. The cycle through the loop provides automatic timing for note duration. Q=1 ^ 1 is used for timing pure tones.

Program 1 is a direct comparison between notes with and without an ADSR amplitude envelope. The S0$ envelope here is that of a struck instrument. Note that the first value in S0$ is 15 for shortest Attack, then a 12 to provide a slower decay, three 08's for sustain, and then 04 and 00 for a slower release. You will certainly notice the difference in tones when you run the program; in fact, the switch from envelope to no envelope is itself a pleasing effect.

Program 2 offers a somewhat different effect by playing two chords with and without the envelope.

Program 3 introduces the effect of harmonics on a single note and again gives a side-by-side comparison. These are the even harmonics found in pianos. Note several points here. In most instruments the fundamental frequency is the loudest, then the harmonics. And the fourth harmonic may be louder than the second. In real instruments there are both odd and even harmonics. A string plucked in the center produces a different sound than a string plucked near the end. I have ignored both of these points in this program.

Program 4 is similar to Program 3 except that it provides odd harmonics with and without the ADSR envelope. Program 5 compares even and odd harmonics with the envelope. In both programs I have ignored the complications—or let's say that I have created a musical sound that cannot be duplicated by a musical instrument.

Remember, the objective of this article was to show ways to add color to your sounds, not to synthesize the Boston Symphony Orchestra. So let me give you some further suggestions. In any of these programs, change line 20 to FOR I=8 TO 1 STEP − 1 and you will have a sound that can be duplicated only by playing a tape recorder backwards. How about adding odd and even harmonics of the same fundamental frequency? Perhaps instead of having the Release part of the envelope go to 00, it would go back up to 15. How about using one of the sound channels to add the slight bit of noise that goes along with some instruments?

Please refer to "COMPUTE!'s Guide To Typing In Programs" before entering these listings.

Program 1: Notes With And Without ADSR Envelope

```
PK Ø GOTO 1ØØ
KM 1Ø REM Sound envelope
AK 2Ø FOR I=1 TO 25
CN 21 TRAP 23:R=VAL(S$(2*I-1,2*I)):T
      RAP 4ØØØØ
LE 22 POKE 53761,16Ø+R:POKE 53763,16Ø
      +R:POKE 53765,16Ø+R:POKE 53767,
      16Ø+R:NEXT I
EF 23 RETURN
MI 1ØØ DIM S$(5Ø)
OB 11Ø S$="151208080804Ø2ØØ"
JD 19Ø POKE 53768,243
HE 2ØØ GOSUB 2Ø
JE 29Ø POKE 53768,162
HF 3ØØ GOSUB 2Ø
AE 3Ø5 Q=1^1^1^1
IN 31Ø POKE 53768,243
OJ 312 POKE 53761,168:Q=1^1:POKE 5376
      1,Ø
IP 33Ø POKE 53768,162
OL 332 POKE 53761,168:Q=1^1:POKE 5376
      1,Ø
AD 34Ø Q=1^1^1^1
GL 35Ø GOTO 19Ø
LF 1ØØØ REM Same tones with and witho
        ut envelope
```

Program 2: Chords With And Without ADSR Envelope

```
PK Ø GOTO 1ØØ
KM 1Ø REM Sound envelope
NL 2Ø FOR I=1 TO 8
CN 21 TRAP 23:R=VAL(SØ$(2*I-1,2*I)):T
      RAP 4ØØØØ
LE 22 POKE 53761,16Ø+R:POKE 53763,16Ø
      +R:POKE 53765,16Ø+R:POKE 53767,
      16Ø+R:NEXT I
EF 23 RETURN
MI 1ØØ DIM SØ$(5Ø)
OB 11Ø SØ$="151208Ø8Ø8Ø4Ø2ØØ"
DH 19Ø POKE 53760,243:POKE 53762,193:
      POKE 53764,144:POKE 53766,121
HE 2ØØ GOSUB 2Ø
DG 29Ø POKE 53760,243:POKE 53762,182:
      POKE 53764,144:POKE 53766,121
HF 3ØØ GOSUB 2Ø
AE 3Ø5 Q=1^1^1^1
CM 31Ø POKE 53260,243:POKE 53762,193:
      POKE 53764,144:POKE 53766,121
FD 312 POKE 53761,168:POKE 53763,168:
      POKE 53765,168:POKE 56767,168
OD 32Ø Q=1^1
DE 322 POKE 53761,16Ø:POKE 53763,16Ø:
      POKE 53765,16Ø:POKE 56767,16Ø
CM 33Ø POKE 53260,243:POKE 53762,182:
      POKE 53764,144:POKE 53766,121
FF 332 POKE 53761,168:POKE 53763,168:
      POKE 53765,168:POKE 56767,168
AD 34Ø Q=1^1^1^1
GL 35Ø GOTO 19Ø
MD 1ØØØ REM Two chords with and witho
       ut envelope
```

Program 3: Even Harmonics With And Without ADSR Envelope

```
PK Ø GOTO 1ØØ
KM 1Ø REM Sound envelope
NL 2Ø FOR I=1 TO 8
CN 21 TRAP 23:R=VAL(SØ$(2*I-1,2*I)):T
      RAP 4ØØØØ
LE 22 POKE 53761,16Ø+R:POKE 53763,16Ø
      +R:POKE 53765,16Ø+R:POKE 53767,
      16Ø+R:NEXT I
EF 23 RETURN
MI 1ØØ DIM SØ$(5Ø)
OB 11Ø SØ$="151208Ø8Ø8Ø4Ø2ØØ"
ML 19Ø POKE 53760,243:POKE 53762,121:
      POKE 53764,6Ø:POKE 53766,4Ø
HE 2ØØ GOSUB 2Ø
KE 29Ø POKE 53760,162:POKE 53762,81:P
      OKE 53764,4Ø:POKE 53766,27
HF 3ØØ GOSUB 2Ø
AE 3Ø5 Q=1^1^1^1
MF 31Ø POKE 53760,243:POKE 53762,121:
      POKE 53764,6Ø:POKE 53766,4Ø
FD 312 POKE 53761,168:POKE 53763,168:
      POKE 53765,168:POKE 56767,168
OD 32Ø Q=1^1
DE 322 POKE 53761,16Ø:POKE 53763,16Ø:
      POKE 53765,16Ø:POKE 56767,16Ø
JP 33Ø POKE 53760,162:POKE 53762,81:P
      OKE 53764,4Ø:POKE 53766,27
FF 332 POKE 53761,168:POKE 53763,168:
      POKE 53765,168:POKE 56767,168
AD 34Ø Q=1^1^1^1
GL 35Ø GOTO 19Ø
MD 1ØØØ REM Even harmonics envelope a
       nd no envelope
```

Program 4: Odd Harmonics With And Without ADSR Envelope

```
PK Ø GOTO 1ØØ
KM 1Ø REM Sound envelope
NL 2Ø FOR I=1 TO 8
CN 21 TRAP 23:R=VAL(SØ$(2*I-1,2*I)):T
      RAP 4ØØØØ
LE 22 POKE 53761,16Ø+R:POKE 53763,16Ø
      +R:POKE 53765,16Ø+R:POKE 53767,
      16Ø+R:NEXT I
EF 23 RETURN
MI 1ØØ DIM SØ$(5Ø)
OB 11Ø SØ$="151208Ø8Ø8Ø4Ø2ØØ"
KL 19Ø POKE 53760,243:POKE 53762,81:P
      OKE 53764,49:POKE 53766,35
HE 2ØØ GOSUB 2Ø
KB 29Ø POKE 53760,162:POKE 53762,54:P
      OKE 53764,32:POKE 53766,23
HF 3ØØ GOSUB 2Ø
AE 3Ø5 Q=1^1^1^1
KF 31Ø POKE 53760,243:POKE 53762,81:P
      OKE 53764,49:POKE 53766,35
FD 312 POKE 53761,168:POKE 53763,168:
      POKE 53765,168:POKE 56767,168
OD 32Ø Q=1^1
DE 322 POKE 53761,16Ø:POKE 53763,16Ø:
      POKE 53765,16Ø:POKE 56767,16Ø
JM 33Ø POKE 53760,162:POKE 53762,54:P
      OKE 53764,32:POKE 53766,23
FF 332 POKE 53761,168:POKE 53763,168:
      POKE 53765,168:POKE 56767,168
AD 34Ø Q=1^1^1^1
GL 35Ø GOTO 19Ø
EM 1ØØØ REM Odd harmonics envelope an
       d no envelope
```

Program 5: Even And Odd Harmonics With ADSR Envelope

```
PK Ø GOTO 1ØØ
KM 1Ø REM Sound envelope
NL 2Ø FOR I=1 TO 8
CN 21 TRAP 23:R=VAL(SØ$(2*I-1,2*I)):T
      RAP 4ØØØØ
LE 22 POKE 53761,16Ø+R:POKE 53763,16Ø
      +R:POKE 53765,16Ø+R:POKE 53767,
      16Ø+R:NEXT I
EF 23 RETURN
MI 1ØØ DIM SØ$(5Ø)
OB 11Ø SØ$="151208Ø8Ø8Ø4Ø2ØØ"
KL 19Ø POKE 53760,243:POKE 53762,81:P
      OKE 53764,49:POKE 53766,35
HE 2ØØ GOSUB 2Ø
KB 29Ø POKE 53760,162:POKE 53762,54:P
      OKE 53764,32:POKE 53766,23
HF 3ØØ GOSUB 2Ø
AE 3Ø5 Q=1^1^1^1
MF 31Ø POKE 53760,243:POKE 53762,121:
      POKE 53764,6Ø:POKE 53766,4Ø
HI 312 GOSUB 2Ø
JP 33Ø POKE 53760,162:POKE 53762,81:P
      OKE 53764,4Ø:POKE 53766,27
HK 332 GOSUB 2Ø
AD 34Ø Q=1^1^1^1
GL 35Ø GOTO 19Ø
HL 1ØØØ REM Odd and even harmonics wi
       th envelope
```

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How TurboTape Works

Harrie De Ceukelaire
With Ottis Cowper, Technical Editor, And Charles Brannon, Program Editor

Last month COMPUTE! unveiled "TurboTape," a breakthrough program that makes Commodore 64 and VIC-20 tapes save and load as fast as disks. Although it's not necessary to know how TurboTape works in order to use it, this month's article explains the inner workings of the technique for programmers and technicians.

How can an ordinary cassette drive transfer data as fast as a 1541 disk drive? A few months ago, the answer would have been that it can't. But that was before "TurboTape." If you tried the TurboTape program published in last month's COMPUTE!, you know that something unusual is going on. VIC and 64 tapes really do load as fast as 1541 disks—sometimes even faster.

But *how?* TurboTape seems to violate a long-standing rule in personal computing. Tapes are always slower than disks, right?

To understand how TurboTape works, it helps to first understand how normal tape SAVEs and LOADs operate. Commodore's scheme for storing data on tape is quite complex—probably the most sophisticated used by any microcomputer manufacturer. The benefit of this complexity is that the system is extremely reliable. While users of other computers are frequently frustrated by programs that won't load properly from tape, many Commodore tape users never see a ?LOAD ERROR message. The disadvantage is that the complex system leads to long waits for programs to load.

Most microcomputers use an analog tape format. Each byte of the file to be stored on tape is broken down into bits, which in turn are converted to short bursts of audio tones. Two distinct tones symbolize the two states of a bit, either a zero or a one. If you've read much about telecommunications, you'll realize this is the same trick used by modems to transfer data over phone lines.

Digital Squares

Commodore, on the other hand, uses a digital tape format. Rather than recording a particular frequency on the tape, a Commodore computer writes a pattern of square waves (called *dipoles* in Commodore's technical literature) on the tape. The two *poles* are created by alternately recording either a strong signal or an equal period of no signal at all. The Commodore system uses square wave patterns of three different periods (lengths): short, medium, and long. When reading the bits back in, the computer monitors the period of each of the waves, and can—within limits—correct for differences in the length of the dipoles caused by one tape drive running slightly faster or slower than another.

Each byte of data is preceded by a marker consisting of a long square wave followed by a medium one. A 0 bit is represented by a short wave followed by a medium wave, while a 1 bit is the opposite—a medium wave followed by a short one. Each byte on tape ends with a parity bit, which is either 0 or 1 as required to make the total number of 1 bits in the byte odd. The first few bits of a byte on tape might be represented graphically as shown in Figure 1.

Using the parity bit, each byte can be checked as it is retrieved from tape. If there is not an odd number of 1 bits in the byte plus its parity bit, an error results.

Figure 1: Standard Tape Dipole Patterns

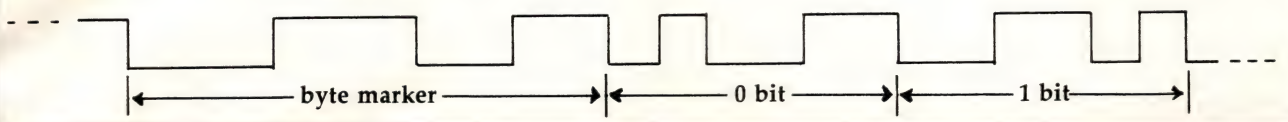


Figure 2: Commodore Tape Storage Layout

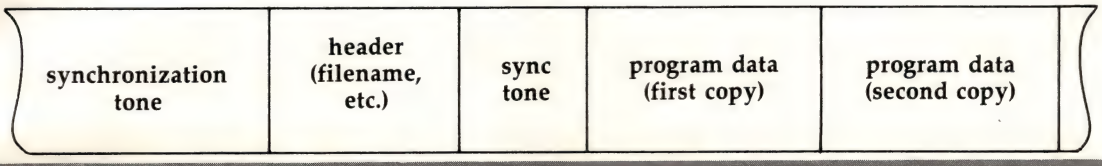


Figure 3:
TurboTape Dipole Patterns

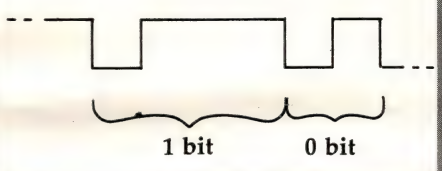


Figure 5: TurboTape Bit-Reading Technique

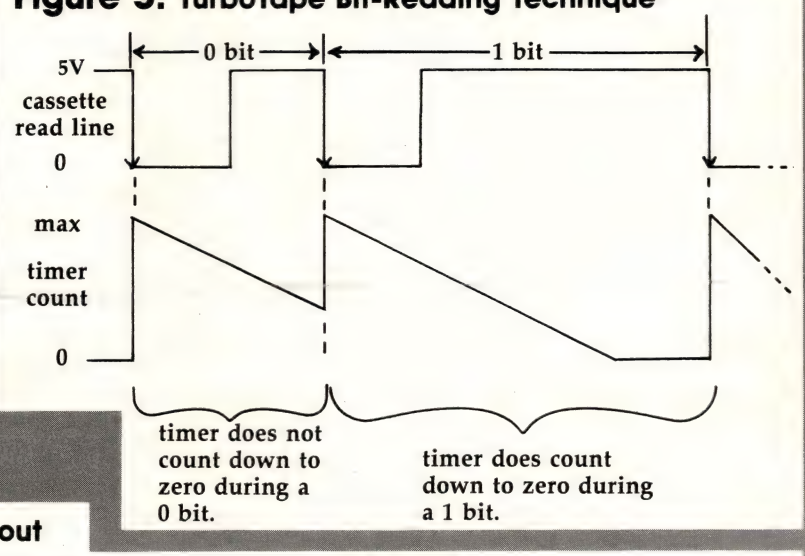
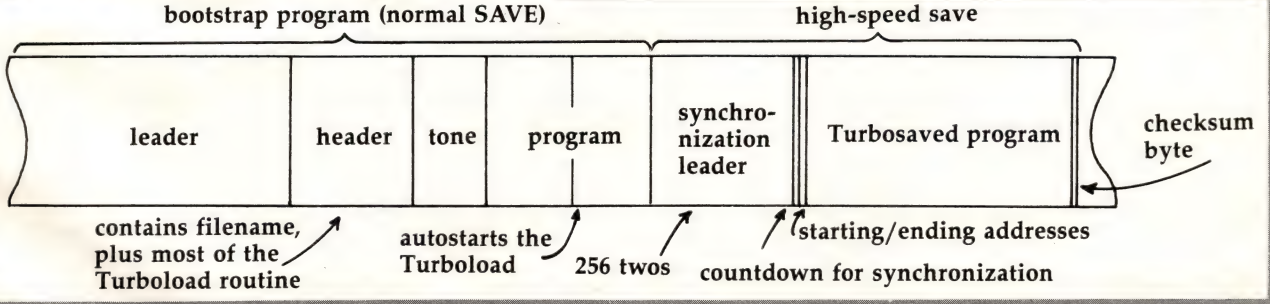


Figure 4: TurboTape Storage Layout



In addition, when you save a program on tape, the computer automatically records it *twice*, end to end. Graphically, a program stored on tape would have the layout shown in Figure 2. If an error is detected in the first recording, the computer remembers where the error occurred and corrects it with data from the second recording. You get the ?LOAD ERROR message only if more than 30 errors are detected on the first pass, or if there are errors in the first pass that can't be corrected in the second.

As you can see, the Commodore tape format is reliable because of its built-in error detection and correction. This, in turn, is the key to speeding up SAVEs and LOADs. Since you can't make the tape run faster, the only alternative is to change the recording format—cut back on Commodore's fail-safe mechanisms. TurboTape uses the bare minimum requirements to store data on tape. It's a method which is much like, yet much simpler than, Commodore's.

Turbowaves

TurboTape also creates a pattern of square waves on the tape, but instead of using a series of square waves to represent 0's and 1's, TurboTape uses a single square wave for each. The duration of the two square waves differs just enough to

permit the loading routine to distinguish between them. TurboTape records the square waves on tape in the same manner as the normal SAVE routine, by toggling the cassette write line. This line comes from bit 3 of the internal input/output port of the 6510 microprocessor (location 1/$0001) in the 64, and from bit 3 of port B of VIA 2 (location 37152/$9120) in the VIC. As long as RECORD and PLAY are pressed on the Datassette, this line controls the signal written to the tape. When the write line is turned on, the recording head of the Datassette generates a magnetic pattern on the tape. When the line is turned off, the erase head of the recorder operates alone, and a blank area of tape passes through.

The TurboTape dipole starts as a transition from 5 volts (the *on* state) to 0 volts (the *off* state) on the cassette write line. In a Turbosave, the trough of the wave is always the same duration, whether the bit is 0 or 1 (thus, the patterns aren't truly *square* waves). Bits are distinguished by the length of the following 5V signal. A shorter 5V signal indicates a 0, and a longer 5V signal indicates a 1 (see Figure 3). So after the first burst of 5V noise, the first period of silence is constant. Following the quiet period, the write line is turned back on. The duration of the write signal determines the value of a bit (the difference in timing is related to the execution time of the routine which Turbowrites a bit, but the duration of a 1 bit is roughly three times as long as for a 0 bit).

Flouting Murphy's Law

The format used for Turbosaving is indeed the most compact method of storing tape data, but without error detection and correction it would not be trustworthy. Many things can go wrong (and according to Murphy's Law *will* go wrong) during a tape LOAD. If only one bit is missed during the LOAD, all of the following bits will be off by one, effectively rotating all the bytes as they are loaded—not a pretty sight.

To help prevent this unbalance, TurboTape precedes the Turbosaved data with a series of synchronization bits. The synchronization leader consists of the byte value of 2 repeated 256 times, followed by a countdown of 9, 8, 7, 6, 5, 4, 3, 2, 1. During a LOAD, TurboTape looks for these bytes. It reads eight bits, then checks to see if the eight bits represent a value of 2. If a 2 is found, TurboTape checks for another 2. Sooner or later, TurboTape runs out of 2's and finds the 9 of the countdown sequence. TurboTape then continues, looking for the rest of the sequence.

Suppose that TurboTape missed one of the bits during synchronization. It would be left with a byte not representing a 2, even if a 2 had been written on tape. At this point, the byte had better be a 9, the start of the countdown, or TurboTape assumes an error. If an error is detected this way, TurboTape assumes a mismatch and tries to find another 2. If TurboTape has found the 2 (instead of an 8 as the next value in the countdown), then even if the bad byte read previously was a 9, TurboTape knows that it was a false 9, not the start of the countdown. As long as the countdown sequence fails, Turbotape keeps trying to find 2's. The block of 2's gives TurboTape 256 opportunities to get into sync.

Assuming all is well, once 2's are no longer being received, TurboTape can verify the correct countdown sequence. TurboTape has insured that it is synchronized with the first bit of actual data. Only if the countdown is mangled will TurboTape fail to synchronize. This leader and countdown system is similar to the one used to synchronize tape reading in the regular SAVE format. If you've ever listened to a stored program on a regular recorder, you've heard the synchronization leader as the steady tone before the header and between the header and the program data.

Following the synchronization leader, the Turbosave routine writes the starting and ending addresses of the program. These are stored as the first four bytes of Turbosaved data. After writing the starting and ending addresses, TurboTape starts writing out bytes from memory, taking the bytes apart bit by bit, beginning at the starting address. As these bytes are written, TurboTape adds them to a checksum value. Since the addition is done in eight bits, the checksum never exceeds 255. It rolls over from 255 to 0, much like an automobile's odometer changes from 99999 to 00000. When the ending address is reached, a checksum is written out as the final byte of the Turbosave.

These are all the steps necessary to save a program at high speed, but the fast SAVE would be useless without a corresponding fast LOAD routine to retrieve the data. And you would lose all the timesaving advantage of the fast SAVE if the fast LOAD routine had to be loaded into memory separately each time you needed to bring a program in from tape. Fortunately, TurboTape provides a loading routine that is transparent to the user.

By Its Own Bootstraps

Each Turbosaved program is preceded on tape by a bootstrap program stored using the normal SAVE format. The bootstrap program contains the entire high-speed loader, so the TurboTape software is not needed to load a Turbosaved program. But how does a normal LOAD become a Turboload?

The portion of the bootstrap program actually saved as a program is quite short: 10 bytes in the 64 version and 14 bytes in the VIC version. The data is saved in nonrelocatable format, so it always loads beginning at location 812 ($032C). It may not be obvious, but this provides a simple but sophisticated way to make the regular LOAD automatically start the Turboload.

One of the last steps the computer takes when completing a standard LOAD is to call the CLALL (CLose ALL files) subroutine in the operating system ROM. CLALL passes through an indirect vector at addresses 812–813 ($32C–32D), but those addresses have been changed by the data from the bootstrap program, so that execution is passed to the start of the Turboload routine at 814 ($32E). However, the few bytes starting from location 814 obviously aren't enough to decipher the data Turbosaved on tape. The major portion of the Turboload machine language routine is in the cassette buffer.

How it gets there is another interesting story. You may not be aware of it, but every program stored on tape has a filename 187 characters long. Each program written to tape by the normal SAVE routine is preceded by a 192-byte header (see Figure 2). The length corresponds to the 192 bytes of the cassette buffer (locations 828–1019). The first five bytes of every tape header are used for a one-byte identifier, a two-byte starting address for the saved program, and a two-byte ending address. The remaining 187 bytes are available for the filename, although only the first 16 are commonly used.

The Turbosave routine makes use of this by filling all the locations after the sixteenth byte of the filename (starting at location 849) with the remainder of the Turboload machine language, where it is written out as part of the filename when the bootstrap program is saved. When the filename is found during the LOAD process, all the data in the program header is loaded into the cassette buffer. Thus, the few bytes of regularly saved data need do little more than transfer control to the remainder of the routine in the buffer. The complete layout of a Turbosaved program would be as shown in Figure 4.

Time Out For Reading

To read a bit, TurboTape makes use of several features of the peripheral interface chips—the CIA (Complex Interface Adapter) on the 64, or the VIA (Versatile Interface Adapter) on the VIC. Each of these chips has a line (FLAG on the CIA and CA1 on the VIA) that can detect a high-to-low signal transition, the beginning of a dipole. These are used as the cassette read lines to the Datassette. To detect the start of a dipole, the Turboload routine monitors bit 4 of location 56333 ($DC0D) on the 64, or bit 1 of location 37165 ($912D) on the VIC. This bit will be set to 1 when the signal being read from tape changes from 5 volts to 0 volts, called the *falling edge* of the dipole (see Figure 5).

To determine whether the bit being read is a 0 or a 1, the Turboload routine starts a timer when the start of the dipole is detected. Each interface adapter chip has two 16-bit timer clocks. On the 64, Timer 2 of CIA #2 is used; the VIC version uses Timer 1 of VIA #1. The timers are like the familiar kitchen timers—they are set for the desired time and allowed to run until the time expires (until they count down to 0). The scheme is to set the timers for a period that is longer than the span of a 0 bit dipole, but shorter than the span of the dipole for a 1 bit. Then, when the next falling edge is detected, the status of the timer is checked. If the timer counted down to 0 before the start of the next dipole, then the time for the bit read was longer than the timer count and thus it was a 1 bit. If the timer is still counting when the next dipole starts, then the length of the dipole being read was shorter than the specified timer count, and thus it was a 0 bit.

The status of the timer can be determined by checking bit 1 of location 56589 ($DD0D) on the 64, or bit 6 of location 37149 ($911D) on the VIC. These will be 0 if the timers are still counting, or 1 if the timers have counted down to 0, which corresponds to the value being read from tape. By collecting these into groups of eight, the bytes of the program can be reassembled. The process is illustrated in Figure 5.

Turboverify operates by reading from tape the bootstrap program for the Turbosaved program to be verified, then modifying some of the Turboload code. It overwrites a store instruction with a compare and branch instruction. Thus, when the Turboload routine takes over, data read from the tape is only compared to the data already in memory, instead of being loaded over the existing data.

The Price Of Speed

After all the program data bytes have been read, one final value is retrieved from the tape. This byte is the checksum previously calculated during the Turbosave. This is the only error detection performed after header synchronization. If the checksum calculated during the Turboload does not match the one read from the tape, the LOAD must have failed.

However, even a correct checksum does not validate a LOAD, because there's more than one way to arrive at a certain sum. Since 2 + 4 + 6 = 1 + 4 + 7, addition is not a fail-safe checksum method. So you must realize that this

speed enhancement does not come without a price. Nevertheless, we've found that the Commodore Datassette is still forgiving enough to make TurboTape reliable.

Unfortunately, the tape reading routines in the bootstrap program are specific to the CIA on the 64 and the VIA on the VIC, since the different chips must be accessed through different memory locations. Also, Turboload makes use of a number of ROM routines that are at different locations in the VIC and 64. So even though the high-speed portion of a Turbosaved program could be read by either machine, the Turboload routine is machine-specific. Since the VIC and 64 Turboload routines are entered automatically, neither routine will work on the wrong machine. There's just not enough room in the cassette buffer for a universal TurboTape LOAD routine that would work on both computers. This means that programs Turbosaved on a 64 can't be loaded into a VIC, and vice versa.

Bypassing Errors

TurboTape works fine in principle, but without a good link with the operating system, it would be cumbersome. For ease of use, TurboTape adds two commands to BASIC: TURBOSAVE (or TSAVE) and TURBOVERIFY (TVERIFY). The TurboTape program as published last month includes a built-in memory mover and relocator.

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When you initialize TurboTape, it copies itself to the top of memory (or optionally beginning at location 52606 on the 64), then corrects all the absolute machine language references such as JMPs, JSRs, and address tables. This relocator actually accounts for 170 of the 812 bytes of machine language in TurboTape.

When you type in the command TURBOSAVE, why don't you get a syntax error? It's certainly not a BASIC command. The answer is that when BASIC sees TURBOSAVE, it knows that TURBO is not a BASIC statement, so it assumes that it is a variable. BASIC then looks for the end of the variable, ready to assign it a value. Suddenly, it finds the command SAVE embedded within TURBOSAVE. A command like SAVE is not allowed as part of a variable name, so BASIC prepares to report a syntax error by jumping with the error code through the indirect error vector, contained in locations 768–769 ($300–$301).

This vector normally points to the BASIC ROM error-handling routines, but this is where TurboTape steps in. When first run, TurboTape changes the error vector to point to the relocated TurboTape machine language. From then on, whenever an error happens, TurboTape gains control. If the error is not a syntax error, TurboTape passes it along to the ROM error routine as usual. (It stores the original contents of 768–769 in 678–679, and uses those locations as its own indirect error vector.) For a syntax error, TurboTape checks for either the SAVE or VERIFY token. Since BASIC has rejected TURBO as a variable, the CHRGET routine is left pointing to the token after TURBO. (CHRGET is used by BASIC to scan for characters in a command or program line. Each call returns a new character and sets up CHRGET to point to the next character.) That's how TurboTape detects the SAVE command.

In fact, almost anything can precede the SAVE (such as SPEEDSAVE or even PIZZASAVE), as long as it's seen as a variable. The token which BASIC points to after the variable must be either 148 (SAVE) or 149 (VERIFY); otherwise, TurboTape jumps back to the normal ROM routine and a ?SYNTAX ERROR is properly reported.

Normal SAVEs do not go to TurboTape, since they do not pass through the error routine. Even if a SAVE ends in an error, CHRGET would no longer be pointing to the token for SAVE. This is an extremely elegant way of adding commands to BASIC, and it wedges into BASIC without interfering with BASIC extensions that use CHRGET (such as the DOS wedge) or other system vectors. ©

C. Regena

Programming Without A Math Background

"Computer literacy," a required class in many high schools and colleges, is often little more than a class in elementary programming. Programming, however, is really only a small part of computing. Equally odd is the fact that many of these computer literacy classes require courses in algebra, calculus, or some other form of advanced mathematics as a prerequisite. In what way would knowing the calculus help someone learn BASIC?

Why are so many young people (often younger than 15) good programmers even if they've never taken algebra? Clearly, advanced mathematics has little to do with programming.

Of course, you do need to know a little about numbers. You need to know how to count. In a BASIC program the lines are numbered, so you must know the order in which the lines will be executed. Nevertheless, if you think logically, you can even use NUM to automatically number your lines as you are typing and you won't even have to worry about the line numbers.

If you like to program graphics, you should also learn something about basic coordinate geometry. That's just a mathematical term for using a grid. There are 24 rows and 32 columns on a TI-99/4A screen. If you want to place a character in a certain position, you have to tell the computer which row and column.

You'll also encounter numbers in the form of codes. For example, each color on a TI is given a number from 1 to 16. In any CALL SCREEN or CALL COLOR statement where you need a color number, you can look on the color chart to see which number represents which color. There are also codes for color sets, sounds, and characters. But beyond that, the most basic knowledge of addition, subtraction, multiplication, and division will be all you'll need in most cases.

Using Numbers Efficiently

Some skill at recognizing number patterns will help make your programs more efficient. Remember, however, that as long as your program works, it is "correct." There are many ways to accomplish the same task.

For instance, if you can recognize a pattern in your programming statements or among the numbers, quite often you can reduce the number of statements required. Suppose you want to draw seven horizontal lines across the screen. The lines are to be in rows 4, 7, 10, 13, 16, 19, and 22. You could use seven CALL HCHAR statements. Notice, though, that the numbers are each separated by 3. If you start with row 4 and add 3 each time until you get to 22, you'll have the lines you want. A FOR-NEXT loop could draw these same lines in only three statements:

```
200 FOR ROW=4 TO 22 STEP 3
210 CALL HCHAR(ROW,1,95,32)
220 NEXT ROW
```

Here's another problem. Suppose you want to draw a flower in several places on the screen, and each flower takes five characters, two on top of three others. The flowers are scattered randomly, so there's no pattern to their placement. In this case, a subroutine to draw the flower would be appropriate. Before you enter the subroutine, you could specify the row and column positions in the variables R and C. In the subroutine, the CALL HCHAR statements (or CALL VCHAR) need to be expressed in terms of R and C. If the upper-left corner of the flower is in position R,C then the next square would be R,C+1. Below R,C is R+1,C and next to it would be R+1,C+1 then R+1,C+2. The subroutine would look like this:

```
500 CALL HCHAR(R,C,112)
510 CALL HCHAR(R,C+1,113)
520 CALL HCHAR(R+1,C,114)
530 CALL HCHAR(R+1,C+1,115)
540 CALL HCHAR(R+1,C+2,116)
550 RETURN
```

And each time you need a flower, you would call the subroutine like this:

```
700 R=3
710 C=8
720 GOSUB 500
```

Streamlining Your Code

Now let's say you're drawing snakes instead of flowers. The snake still takes five characters, but all in a horizontal line. The subroutine might look like this:

```
500 CALL HCHAR(R,C,112)
510 CALL HCHAR(R,C+1,113)
520 CALL HCHAR(R,C+2,114)
530 CALL HCHAR(R,C+3,115)
540 CALL HCHAR(R,C+4,116)
550 RETURN
```

Notice that there is a pattern among the numbers. In each statement the column number increases by 1 and so does the character number. The five CALL HCHAR statements can be changed to:

```
500 FOR A=0 TO 4
510 CALL HCHAR(R,C+A,112+A)
520 NEXT A
```

A young friend came to me with a program in which he was randomly choosing five words, then printing them on rows 5, 7, 9, 11, and 13. He had to keep track of the words, their placement (order), and the answers. One solution was to DIMension arrays of W$ and ANS$ where the element specified was also the row number—so he had W$(R) and ANS$(R), where R was 5, 7, 9, 11, and 13. This method is easy to understand and worked well, but we were running into memory problems. Those arrays were taking up space because we weren't really using all the elements.

Notice that there is a pattern to the numbers:

Word 1—Row 5
Word 2—Row 7
Word 3—Row 9
Word 4—Row 11
Word 5—Row 13

The row numbers increase by 2. If you multiply each word number by 2, they become 2, 4, 6, 8, 10. Now compare these numbers with 5, 7, 9, 11, 13. Each of the word numbers (multiplied by 2) is 3 less than the row numbers. Therefore, if we have a word number N, the row number would be 2*N+3.

Later in the program, if we know the row number R and want to find the word number, we need to relate 5, 7, 9, 11, 13 to 1, 2, 3, 4, 5. First subtract 3 from the row number, then notice that the result is 2 times the word number. Given the row number R, the word number is (R−3)/2.

Quite often, if you line up a group of numbers you can see a relationship or a pattern. You can usually use standard arithmetic operations to get from one column of numbers to the next. If there is a progression of numbers, you can use a FOR-NEXT loop with a certain STEP size to get the right series of numbers.

Programming A Reflection

In this month's example program, we'll see how numbers can be manipulated to simulate reflections in graphics. The program takes a design you draw in the upper-left quadrant of the screen and creates reflections in the other three quadrants. We don't want the pattern simply repeated (as in the "Quilt Squares" program), rather, we want to actually reverse the image.

First, you draw a design in an area defined by rows 2 through 12 and columns 6 through 16. For example, the drawing starts in row 12 and column 16. This particular square reflects onto the other quadrants in squares (12,17), (13,16), and (13,17). The top-left square of the drawing quadrant is (2,6), or row 2 and column 6. The corresponding squares in the other quadrants are (2,27), (23,6), and (23,27).

In general, for a certain row R and column C, the corresponding square in the upper-right quadrant would be on the same row R and the column number would be 17 (the quadrant starts in the seventeenth column) plus (16−C). The first quadrant ends in column 16, and you subtract the first quadrant's column number to get its distance from the center. The result is 33−C. Another way to look at it is that the column number will be the same distance from the last column as the original square is from the first column—thus 32−C+1 or 33−C.

The corresponding square in the lower-left quadrant will have the same column number C as the original square, but the row will be 12+13−R or 24+R−1, which is 25−R. The lower-right quadrant has the same row as the lower-left quadrant and the same column as the upper-right quadrant. Thus the three corresponding squares are (R,33−C) and (25−R,C) and (25−R,33−C). Lines 620–640 and 1000–1020 use these relationships.

Electronic Snowflake

When I was a child I liked to fold paper, cut a design, then unfold the paper to see what it looked like. Sometimes we would fold the paper to get a six-sided snowflake. Other times we

would fanfold the paper. We also used different variations of simply folding the paper into rectangles.

This "Snowflake" program is the computerized version of cutting paper snowflakes (with no scraps of paper to clean up). Suppose you have a square piece of paper. Fold it in half to make a rectangle, then fold the rectangle in half to make a square. Now cut a design in that square. Unfold the paper and you have a four-sided snowflake.

When you run this program, you will see a large square outlined. You can draw in the upper-left square only. Use the arrow keys to move the cursor, press F to fill the cursor position with color, and press the space bar to preserve the background color (or to erase a previously filled position). When your design is complete, press ENTER. The computer starts at the center and moves outward to reflect your pattern on the other quadrants of the larger square.

When the design is complete, you can press M to modify, S to start a new pattern, P to print the pattern if you have a printer, and ENTER to end the program. If you press M to modify, the cursor starts blinking again and you can resume drawing. But this time your changes appear immediately in the rest of the design. When you're finished, you can press ENTER again. If you press S to start a new pattern, the screen clears and you can start over.

To use the printer option, the printer must be attached and switched on (don't forget the RS-232 interface). Line 800 contains the printer configurations; modify it if necessary. The hard copy printout is elongated but shows the pattern you drew. Filled squares are represented by asterisks and the blanks by dots. If you want, you could even use this pattern for counted cross-stitching or needlepoint.

Program Explanation

Lines 110–200 clear the screen and print the title and instructions. Lines 210–270 define characters used as graphics. Characters 96–99 are used to outline the large square and the drawing quadrant. Character 104 is the filled square, and character 105 is the cursor used in drawing. Character 112 is the yellow dot used to indicate the ENTER key after the snowflake is complete. Lines 280–290 define the colors for the snowflake and the ENTER key symbol. If you wish to use different colors for the snowflake, change the color number 5 in line 280 and the screen color in line 430.

Lines 300–390 wait for you to press ENTER, then continue the instructions. Lines 400–410 wait for you to press any key to start. Lines 420–490 clear the screen, change the screen color to cyan (light blue), then outline the large square and the upper-right quadrant.

Lines 500–510 define the starting row X and column Y for the drawing cursor. Lines 520–540 call the subroutine that is the procedure for moving and filling in squares until the ENTER key is pressed.

When you press ENTER, lines 550–570 make a beeping sound, then erase the lines for the quadrant. Lines 580–660 look at each square in the upper-right quadrant. If they find a filled square, they draw a square in the other quadrants in the corresponding position. This happens in loops, starting with the center square and moving outward (by columns C) and upward (by rows R). When the process is complete, line 670 sounds another beep.

Lines 680–730 print the options to press M for modify, S to start over, P to print, or ENTER to end. Lines 740–780 detect the key pressed and branch accordingly.

Lines 790–920 contain the printing option. You must have a printer connected, and your printer configuration must be specified in line 800. The computer looks at each row from 2 to 23 and each column from 6 to 27 using CALL GCHAR, and then prints a period for a space and an asterisk for a filled square. After the printing is complete, the program branches back to the options of M, S, P, and ENTER.

Lines 930–1030 contain the modify option. First the options at the right of the square are cleared. Then the drawing cursor reappears. Design changes instantly appear in the other three quadrants. When you press ENTER, the program branches back to the options of M, S, P, and ENTER.

Lines 1040–1320 contain the subroutine for the drawing procedure. CALL GCHAR checks to see what character is in position X,Y and calls that character number (G). Lines 1060–1080 blink the cursor while waiting for a keypress. Lines 1090–1300 are the branching statements executed when certain keys are pressed. Line 1310 draws the new character if it is a space or a filled square.

Lines 1330–1340 clear the screen, then end the program.

If you wish to save typing, you can receive a copy of this program by sending a blank cassette or disk, a stamped, self-addressed mailer, and $3 to:

C. Regena
P.O. Box 1502
Cedar City, UT 84720

Please be sure to specify that you need the TI version of Snowflake.

Snowflake

Refer to "COMPUTE!'s Guide To Typing In Programs" before entering this listing.

```
100 REM  SNOWFLAKE
110 CALL CLEAR
120 PRINT TAB(9);"SNOWFLAKE":::
130 PRINT "USE THE ARROW KEYS TO DR
    AW"
140 PRINT :"IN THE UPPER LEFT QUADR
    ANT."
150 PRINT :"PRESS 'F' TO FILL A SQU
    ARE."
160 PRINT :"PRESS SPACE BAR TO ERAS
    E."
170 PRINT :"PRESS <ENTER> WHEN YOU"
180 PRINT :"ARE FINISHED DRAWING."
190 PRINT ::"THE COMPUTER WILL COMP
    LETE"
200 PRINT :"THE SNOWFLAKE."
210 CALL CHAR(96,"0000000000000000FF")
220 CALL CHAR(97,"8080808080808080")
230 CALL CHAR(98,"FF")
240 CALL CHAR(99,"0101010101010101")
250 CALL CHAR(104,"FFFFFFFFFFFFFFFF
    ")
260 CALL CHAR(105,"FF818181818181FF
    ")
270 CALL CHAR(112,"3C7EFFFFFFFF7E3C
    ")
280 CALL COLOR(10,5,1)
290 CALL COLOR(11,12,1)
300 PRINT ::"PRESS <ENTER>."
310 CALL KEY(0,K,S)
320 IF K<>13 THEN 310
330 CALL CLEAR
340 PRINT "AFTER SNOWFLAKE IS COMPL
    ETE,"
350 PRINT :"PRESS <M> TO MODIFY PAT
    TERN"
360 PRINT :"PRESS <S> TO START OVER"
370 PRINT :"PRESS <P> TO PRINT COPY"
380 PRINT :"PRESS <ENTER> TO END."
390 PRINT :::::"PRESS ANY KEY NOW T
    O START."
400 CALL KEY(0,K,S)
410 IF S<1 THEN 400
420 CALL CLEAR
430 CALL SCREEN(8)
440 CALL HCHAR(1,6,96,22)
450 CALL VCHAR(2,28,97,22)
460 CALL HCHAR(24,6,98,22)
470 CALL VCHAR(2,5,99,22)
480 CALL VCHAR(2,17,97,11)
490 CALL HCHAR(13,6,98,11)
500 X=12
510 Y=16
520 CALL SOUND(150,1397,2)
530 GOSUB 1050
540 IF K<>13 THEN 530
550 CALL SOUND(100,1497,2)
560 CALL HCHAR(13,6,32,11)
570 CALL VCHAR(2,17,32,11)
580 FOR R=12 TO 2 STEP -1
590 FOR C=16 TO 6 STEP -1
600 CALL GCHAR(R,C,H)
610 IF H=32 THEN 650
620 CALL HCHAR(R,33-C,H)
630 CALL HCHAR(25-R,C,H)
640 CALL HCHAR(25-R,33-C,H)
650 NEXT C
660 NEXT R
670 CALL SOUND(100,440,2)
680 CALL VCHAR(8,29,60,4)
690 CALL VCHAR(8,31,62,4)
700 CALL HCHAR(8,30,77)
710 CALL HCHAR(9,30,83)
720 CALL HCHAR(10,30,80)
730 CALL HCHAR(11,30,112)
740 CALL KEY(0,K,S)
750 IF S<1 THEN 740
760 IF K=83 THEN 420
770 IF K=13 THEN 1330
780 IF K<>80 THEN 930
790 REM  PRINTER CONFIGURATION
800 OPEN #1:"RS232.BA=600"
810 FOR R=2 TO 23
820 FOR C=6 TO 27
830 CALL GCHAR(R,C,H)
840 IF H<>32 THEN 870
850 PRINT #1:".";
860 GOTO 880
870 PRINT #1:"*";
880 NEXT C
890 PRINT #1:CHR$(13)
900 NEXT R
910 CLOSE #1
920 GOTO 670
930 IF K<>77 THEN 740
940 CALL VCHAR(8,29,32,4)
950 CALL VCHAR(8,30,32,4)
960 CALL VCHAR(8,31,32,4)
970 CALL SOUND(150,1397,2)
980 GOSUB 1050
990 IF K=13 THEN 670
1000 CALL HCHAR(X,33-Y,G1)
1010 CALL HCHAR(25-X,Y,G1)
1020 CALL HCHAR(25-X,33-Y,G1)
1030 GOTO 970
1040 REM  SUB TO DRAW
1050 CALL GCHAR(X,Y,G)
1060 CALL KEY(0,K,S)
1070 CALL HCHAR(X,Y,105)
1080 CALL HCHAR(X,Y,G)
1090 IF K=13 THEN 1320
1100 IF K=70 THEN 1300
1110 IF K=32 THEN 1280
1120 IF K<>88 THEN 1160
1130 IF X=12 THEN 1060
1140 X=X+1
1150 GOTO 1050
1160 IF K<>83 THEN 1200
1170 IF Y=6 THEN 1060
1180 Y=Y-1
1190 GOTO 1050
1200 IF K<>68 THEN 1240
1210 IF Y=16 THEN 1060
1220 Y=Y+1
1230 GOTO 1050
1240 IF K<>69 THEN 1060
1250 IF X=2 THEN 1060
1260 X=X-1
1270 GOTO 1050
1280 G1=32
1290 GOTO 1310
1300 G1=104
1310 CALL HCHAR(X,Y,G1)
1320 RETURN
1330 CALL CLEAR
1340 END
```

©

MACHINE LANGUAGE

Jim Butterfield, Associate Editor

Multiplication Part 2

In Part 1, we discussed a multiplication such as:

```
(x)             1 1 0 1 0
(y)               1 0 1
-------------------------
                1 1 0 1 0
              0 0 0 0 0
            1 1 0 1 0
-------------------------
(z)     1 0 0 0 0 0 1 0
```

We indicated that the logic might most usefully work this way:

1. Set the product area (z) to zero.
2. Examine the highest bit of the multiplier (y).
3. If the bit is 1, add the multiplicand (x) into the product (z).
4. If the multiplier (y) has no more bits, quit.
5. Shift the product (z) left one bit.
6. Examine the next highest bit of the multiplier, and go to step 3.

Thus, we start with 11010, shift left to get 110100, add nothing, shift left to get 1101000, add 11010 to give 10000010, then quit. Answer: 10000010, or hex 82, or decimal 130.

Working Another Shift

That's not hard to do, but we have one more trick in our bag. Notice that the product is shifted left. We could test the bits of the multiplier (y) if we shifted it left, too. The highest bits would pop into the carry flag as we shifted, and we could test each bit with a BCC or BCS as it goes by.

Now—and this is the neat part—if we need to shift both the product and the multiplier left, maybe we could put them together and shift them as one large collection of bits. We can see this best graphically:

```
00000101 00000000
Multiplier  Product
```

We'll shift these two as if they were one value. Whenever a bit hits the carry flag, we'll add 11010 (our multiplicand) into the product area. Nothing much will happen at first, since as we shift the two-byte group left, zeros will move into the carry and we won't add a thing. After five shifts, we have:

```
10100000 00000000
```

We still have nothing in our carry flag. But one more long shift, and the high bit will move into the carry:

```
C 01000000 00000000
```

Good! Add the multiplicand into the product area (using a full two-byte addition), and we'll get:

```
01000000 00011010
```

The next two left-shifts yield the following values:

```
          10000000 00110100
and     C 00000000 01101000
```

Aha! The carry bit has been hit again, so we add 11010 into the product area to get:

```
00000000 10000010
```

That's our answer! Correct in both bytes! We know to stop at this point because if we count the shifts we find that we've done eight—exactly the number of bits in the multiplier.

Taking A Bigger Byte

The elegant thing about this kind of multiplication is that the answer is correct over several bytes. For example, if you multiply a one-byte number by another one-byte number, the product may be up to two bytes in length. Our previous example was a simple one: 5 times 26 gives 130, which still fits into one byte. But if we try, say, 48 times 40, we'll need a two-byte area for the answer. Without special comment, let's do it using the same method:

```
  00101000  00000000
  01010000  00000000
  10100000  00000000
C 01000000  00110000
  10000000  01100000
C 00000000  11110000
  00000001  11100000
  00000011  11000000
  00000111  10000000
```

Answer: hex 780, or decimal 1920. Correct in both bytes.

Let's write the code to multiply a number in the A register with one in the X register and place the result in address $0380 (low) and $0381 (high). We'll use $0382 as storage for the multiplicand.

```
        STX   $0382   ;multiplicand
        STA   $0381   ;multiplier
        LDA   #$00
        STA   $0380   ;zero to product
        LDX   #$08    ;number of bits
NXBIT   ASL   $0380
        ROL   $0381
        BCC   NOADD
        CLC
        LDA   $0381
        ADC   $0382
        STA   $0381
        LDA   $0380
        ADC   #$00
        STA   $0380
NOADD   DEX
        BNE   NXBIT
```

It's elegant, it's efficient, and it easily extends to a greater number of bytes for the multiplier and multiplicand. ©

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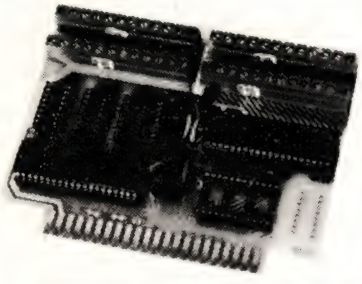

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IBM Rebound

All Machine Language Game For PC & PCjr

Chris Metcalf and Marc Sugiyama

Here's a fast, smooth, all machine language adaptation of a classic arcade game. With the modifications included below, it runs on any IBM PC (color/graphics or monochrome adapter) with at least 64K RAM and a disk drive, and any Enhanced Model PCjr.

"Rebound" takes advantage of machine language to streamline the action in this arcade-style game patterned after the popular *Breakout*. By controlling a paddle at the bottom of the screen, your goal is to knock out all the bricks at the top of the screen with a bouncing ball.

Unlike most action games, Rebound works on all three popular types of IBM Personal Computers. Program 1 is for an IBM PC with the color/graphics adapter. Program 2 consists of modifications to make Program 1 work on an IBM PC with the monochrome adapter. And although Program 1 works as is on an IBM PCjr, the modifications contained in Program 3 accelerate the game to compensate for Junior's slower execution speed.

Typing Instructions

If you have a color/graphics PC, type in Program 1. If you have a monochrome PC, type in Program 1 and substitute the lines in Program 2. If you have a PCjr, type in Program 1 and substitute the lines in Program 3. *To be safe, save the program on disk before running it for the first time.*

Next, insert a disk in drive A and type RUN. The BASIC program will create a machine language file on disk with the filename REBOUND.EXE (the drive may whir on and off a few times as the file is created).

When the Ok prompt reappears, exit BASIC to DOS by typing SYSTEM. Make sure the disk with the REBOUND.EXE file is in drive A. To run Rebound, type REBOUND.EXE at the DOS prompt. Almost instantly, the game screen will appear.

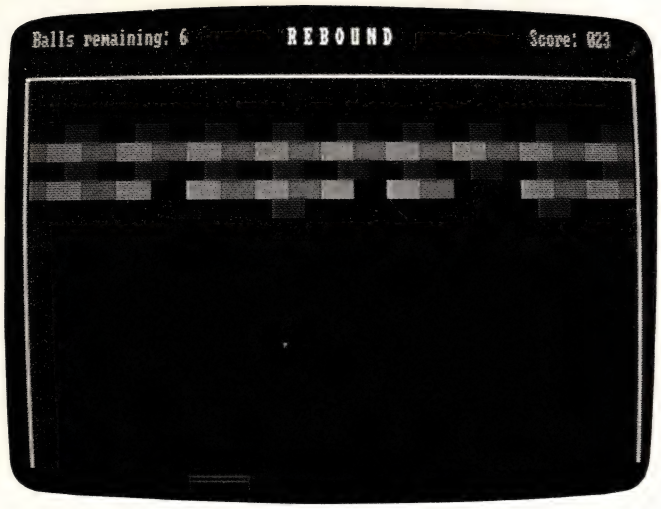
Eight Chances For Glory

To start playing Rebound, press the Enter key. The first ball starts moving downward from the middle of the screen. Your job is to keep it from falling off the bottom of the screen by bouncing it upward toward the rows of bricks.

To bounce the ball, move the paddle back and forth with the left and right Shift keys. You'll have to anticipate where the ball will bounce next, because the paddle can't always move across the screen as fast as the ball can (otherwise the game would be too easy). If you miss a ball, another one starts falling. You get a total of eight balls before the game ends in defeat. If you succeed in knocking out all the bricks, the program resets for another game.

There are five rows of bricks. Bricks on the lowest row are worth one point each, bricks on the second-lowest row are worth two points, etc.

You can freeze Rebound at any time by pressing the space bar. Press any other key to resume play.



"Rebound" is a fast arcade-style game that works on nearly all IBM Personal Computers.

The Esc key restarts a game in progress by replacing all missing bricks and lost balls. It also resets the score to zero.

To stop the game entirely and exit to DOS, press Ctrl-Break on the PC or Function-Break (Fn-B) on the PCjr.

Refer to "COMPUTE!'s Guide To Typing In Programs" article before typing these programs in.

Program 1: Rebound For IBM PC (Color/Graphics)

```
EL 10 ON ERROR GOTO 70
FB 20 OPEN "o",1,"rebound.exe"
CH 30 READ A : IF A<0 THEN 50
NE 40 PRINT #1,CHR$(A); : GOTO 30
EP 50 FOR I=1 TO -1*A : PRINT #1,CHR$(
      0); : NEXT
HJ 60 GOTO 30
QK 70 IF ERR <> 4 THEN ON ERROR GOTO 0
CB 80 CLOSE 1 : END
BF 100 DATA 77,90,32,1,4,0,1,0
KH 110 DATA 32,-3,255,255,74,0,128,0
ID 120 DATA 208,144,-4,32,-3,205,11,-2
PK 130 DATA 6,-479,30,184,-2,80,184,59
OK 140 DATA 0,142,216,142,192,176,3,18
       0
DN 150 DATA 0,205,16,185,-2,182,24,178
OC 160 DATA 79,176,0,183,7,180,6,205
FP 170 DATA 16,181,32,180,1,205,16,182
FD 180 DATA 3,178,3,183,0,232,107,3
DB 190 DATA 176,218,179,15,232,107,3,1
       78
BC 200 DATA 4,232,95,3,176,196,185,72
ME 210 DATA 0,232,97,3,178,76,232,82
LH 220 DATA 3,176,191,232,84,3,182,4
NA 230 DATA 178,3,232,70,3,176,179,232
FI 240 DATA 72,3,178,76,232,60,3,176
NN 250 DATA 179,232,62,3,254,198,128,2
       54
CG 260 DATA 24,114,229,178,4,182,1,190
DM 270 DATA 199,0,232,223,2,198,6,45
OD 280 DATA 0,56,191,3,0,198,133,94
QL 290 DATA 0,48,79,117,248,190,26,0
BP 300 DATA 232,179,2,198,6,10,0,92
EH 310 DATA 198,6,6,0,128,198,6,8
NH 320 DATA -2,191,5,0,182,5,178,4
JF 330 DATA 183,0,190,182,0,247,199,1
AF 340 DATA 0,117,3,190,189,0,185,9
OM 350 DATA 0,232,159,2,226,251,232,11
       3
OJ 360 DATA 2,79,117,224,128,62,11,-2
BL 370 DATA 117,18,198,6,11,0,1,232
NN 380 DATA 166,2,128,62,12,0,1,117
OB 390 DATA 3,233,106,1,254,14,45,0
BI 400 DATA 128,62,45,0,48,115,3,233
FJ 410 DATA 145,1,190,26,0,232,84,2
QP 420 DATA 182,24,178,0,190,225,0,232
HB 430 DATA 96,2,198,6,9,0,35,180
OC 440 DATA 0,205,26,139,194,37,255,15
GB 450 DATA 178,20,246,242,128,196,4,2
       46
QO 460 DATA 196,1,116,3,128,196,52,138
IL 470 DATA 212,182,11,137,22,-2,198,6
DB 480 DATA 4,0,2,128,252,39,119,5
BN 490 DATA 198,6,4,0,3,180,2,205
DH 500 DATA 22,36,3,116,25,60,3,116
IF 510 DATA 21,60,1,116,2,176,255,2
MH 520 DATA 6,9,0,60,2,124,7,60
BG 530 DATA 68,127,3,162,9,0,232,46
IC 540 DATA 1,160,6,0,44,127,177,10
JL 550 DATA 246,225,247,216,5,160,15,1
       39
KC 560 DATA 200,226,254,160,5,0,2,6
JP 570 DATA 6,0,162,5,0,114,3,233
QM 580 DATA 173,0,139,22,-2,160,4,0
FI 590 DATA 36,1,208,224,44,1,2,208
QK 600 DATA 160,4,0,36,2,44,1,128
CB 610 DATA 54,7,0,1,117,2,176,0
PC 620 DATA 2,240,128,254,24,119,39,18
       3
CB 630 DATA 0,232,3,2,180,8,205,16
FB 640 DATA 60,32,116,88,191,13,0,185
EK 650 DATA 4,0,252,242,174,117,41,232
AH 660 DATA 247,0,128,54,4,0,2,198
CP 670 DATA 6,7,-2,235,179,139,22,2
PH 680 DATA 0,232,213,0,139,22,-2,232
KL 690 DATA 206,0,232,175,0,180,14,176
EK 700 DATA 7,205,16,233,2,255,191,17
LH 710 DATA 0,185,3,0,242,174,117,5
BC 720 DATA 128,54,4,0,1,191,20,0
KA 730 DATA 185,6,0,242,174,116,3,233
JF 740 DATA 125,255,128,54,4,0,2,233
BA 750 DATA 117,255,128,54,8,0,1,117
JM 760 DATA 19,82,139,22,2,0,232,143
GK 770 DATA 0,90,232,124,0,137,22,-2
LH 780 DATA 235,9,144,135,22,-2,137,22
HB 790 DATA 2,0,180,1,205,22,116,39
MC 800 DATA 180,0,205,22,128,252,1,117
AC 810 DATA 8,198,6,11,-2,233,219,253
DK 820 DATA 60,32,117,7,180,0,205,22
KG 830 DATA 235,12,144,10,196,117,7,17
       6
GG 840 DATA 3,180,0,205,16,203,128,62
CI 850 DATA 10,-2,116,3,233,215,254,19
       0
PC 860 DATA 99,0,232,231,0,139,22,2
OD 870 DATA 0,232,56,0,139,22,-2,232
MF 880 DATA 49,0,232,18,0,232,7,1
NP 890 DATA 128,62,12,0,1,116,206,233
```

```
KG 900 DATA 151,253,190,128,0,235,218,
       182
GN 910 DATA 24,138,22,9,0,190,209,0
GF 920 DATA 232,206,0,195,82,183,0,232
FM 930 DATA 14,1,176,9,179,3,232,14
HN 940 DATA 1,90,195,82,183,0,232,255
JE 950 DATA 0,176,32,179,7,232,255,0
DD 960 DATA 90,195,254,14,10,0,83,81
LE 970 DATA 82,86,138,254,128,238,6,12
       8
QM 980 DATA 230,1,208,230,128,234,4,42
ME 990 DATA 214,128,226,252,2,214,185,
       4
OP 1000 DATA 0,121,5,178,0,185,2,0
PE 1010 DATA 128,194,4,138,247,128,250
        ,74
ED 1020 DATA 114,3,185,2,0,183,0,232
BE 1030 DATA 190,0,176,32,179,7,232,19
        3
AF 1040 DATA 0,183,11,42,254,2,62,97
GO 1050 DATA 0,136,62,97,0,183,58,190
FK 1060 DATA 2,0,58,188,95,0,119,18
DF 1070 DATA 138,156,95,0,128,235,10,1
        36
DM 1080 DATA 156,95,0,254,132,94,0,78
GN 1090 DATA 117,232,190,26,0,232,43,0
DH 1100 DATA 128,238,6,177,5,210,230,2
        46
CP 1110 DATA 214,58,54,6,0,114,4,136
HA 1120 DATA 54,6,0,94,90,89,91,195
AC 1130 DATA 82,176,1,181,5,177,4,182
PL 1140 DATA 23,178,75,183,7,180,7,205
JH 1150 DATA 16,90,195,83,173,139,208,
        183
GL 1160 DATA 0,232,84,0,172,60,0,116
HJ 1170 DATA 6,180,14,205,16,235,245,9
        1
CN 1180 DATA 195,81,86,183,0,232,64,0
DM 1190 DATA 172,60,0,116,15,138,200,1
        81
MD 1200 DATA 0,172,138,216,172,232,58,
        0
DB 1210 DATA 2,209,235,233,94,89,195,2
        32
DA 1220 DATA 19,0,190,161,0,232,195,25
        5
IB 1230 DATA 180,0,205,22,10,196,116,1
        8
FI 1240 DATA 128,252,28,117,243,139,22
        ,161
CA 1250 DATA 0,178,4,190,229,0,232,192
LJ 1260 DATA 255,195,198,6,12,0,1,195
PD 1270 DATA 80,180,2,205,16,88,195,18
        5
GO 1280 DATA 1,0,180,9,205,16,195,-19
EH 1290 DATA 219,219,219,219,179,218,1
        91,196
BP 1300 DATA 205,218,191,213,184,4,1,6
        6
PB 1310 DATA 97,108,108,115,32,114,101
        ,109
PF 1320 DATA 97,105,110,105,110,103,58
        ,32
JM 1330 DATA 0,32,32,32,32,32,32,32
NI 1340 DATA 32,32,32,32,32,82,32,69
GE 1350 DATA 32,66,32,79,32,85,32,78
JJ 1360 DATA 32,68,32,32,32,32,32,32
BI 1370 DATA 32,32,32,32,32,32,32,32
PF 1380 DATA 32,32,32,83,99,111,114,10
        1
NL 1390 DATA 58,32,-4,27,2,67,111,110
EN 1400 DATA 103,114,97,116,117,108,97
        ,116
HE 1410 DATA 105,111,110,115,33,32,32,
        89
LJ 1420 DATA 111,117,32,119,105,110,33
        ,0
EO 1430 DATA 25,2,84,114,105,117,109,1
        12
PA 1440 DATA 104,33,32,32,78,111,116,1
        04
NJ 1450 DATA 105,110,103,32,99,97,110,
        32
LF 1460 DATA 115,116,111,112,32,109,10
        1,33
GJ 1470 DATA 0,31,16,72,105,116,32,69
FD 1480 DATA 110,116,101,114,32,116,11
        1,32
CD 1490 DATA 66,101,103,105,110,0,4,1
HM 1500 DATA 219,4,2,219,0,2,4,219
OC 1510 DATA 4,6,219,2,4,219,0,20
DJ 1520 DATA 12,32,24,15,32,26,12,32
OA 1530 DATA 0,1,9,32,1,9,213,6
AD 1540 DATA 9,205,1,9,184,1,9,32
BE 1550 DATA 0,79,9,32,0,72,7,32
NO 1560 DATA -8,83,84,65,67,75,32,32
NL 1570 DATA 32,83,84,65,67,75,32,32
NO 1580 DATA 32,83,84,65,67,75,32,32
NB 1590 DATA 32,83,84,65,67,75,32,32
NI 1600 DATA 32,83,84,65,67,75,32,32
NL 1610 DATA 32,83,84,65,67,75,32,32
NO 1620 DATA 32,83,84,65,67,75,32,32
NB 1630 DATA 32,83,84,65,67,75,32,32
NE 1640 DATA 32,83,84,65,67,75,32,32
NH 1650 DATA 32,83,84,65,67,75,32,32
NK 1660 DATA 32,83,84,65,67,75,32,32
NN 1670 DATA 32,83,84,65,67,75,32,32
NA 1680 DATA 32,83,84,65,67,75,32,32
ND 1690 DATA 32,83,84,65,67,75,32,32
NK 1700 DATA 32,83,84,65,67,75,32,32
NN 1710 DATA 32,83,84,65,67,75,32,32
KG 1720 DATA 32
```

Program 2: Modifications For Monochrome PC

```
OM 1290 DATA 176,177,178,219,179,218,1
        91,196
GC 1490 DATA 66,101,103,105,110,0,4,15
NB 1500 DATA 176,4,7,177,0,2,15,178
FE 1510 DATA 4,7,219,2,15,178,0,20
IG 1520 DATA 7,32,24,15,32,26,7,32
JG 1530 DATA 0,1,7,32,1,7,213,6
JB 1540 DATA 7,205,1,7,184,1,7,32
PE 1550 DATA 0,79,7,32,0,72,7,32
```

Program 3: Modifications For PCjr

```
CN 540 DATA 1,160,6,0,44,127,177,6
BP 550 DATA 246,225,247,216,5,206,9,13
       9
```

©

Apple Bowling Champ

Original Program By Joseph Ganci
Apple Adaptation By Patrick Parrish, Programming Supervisor

Now you can go bowling without the expense of renting special shoes or suffering the embarrassment of rolling a gutter ball in front of dozens of people. "Bowling Champ" is a game for one to four players which runs on any Apple II-series computer.

Some computer games, such as *Pac-Man* or *Adventure*, create their own unique fantasy worlds, while others are simulations of reality. "Apple Bowling Champ" is an example of the latter.

It's not easy to take a game with countless physical variables such as bowling and reduce it to numbers so it can be re-created by a computer—especially a microcomputer. Compromises must be made. Usually the game must be modified in major ways to make it possible to program. The result is a hybrid game, an approximation of reality, that resembles the original but has new aspects of its own.

Apple Bowling Champ is a reasonable simulation of a game of tenpins, given the limitations imposed by a BASIC program which must remain short enough to publish in a magazine. The elements of skill and luck have been preserved, and the scoring is authentic.

Up To Four Players

When you run Bowling Champ, the program asks for the number of players. Up to four people can play. Next, enter the players' names. To fit the names on the 40-column screen, the program truncates entries to eight characters.

Now you're ready to bowl the first frame. The bowling ball moves rapidly up and down across the alley until you press the space bar. This rolls the ball down the alley and knocks over the pins—unless you've thrown a gutter ball. The trick is to time your release so the ball rolls down the center of the alley to score a strike.

In case you're unfamiliar with how a game of tenpins is scored, here's a brief summary.

A game consists of ten frames or turns. Each player gets one or two balls per frame. If you roll a strike—knocking down all tenpins with your first ball—you don't get a second ball, but the current ball's score is ten plus the total of your next two throws.

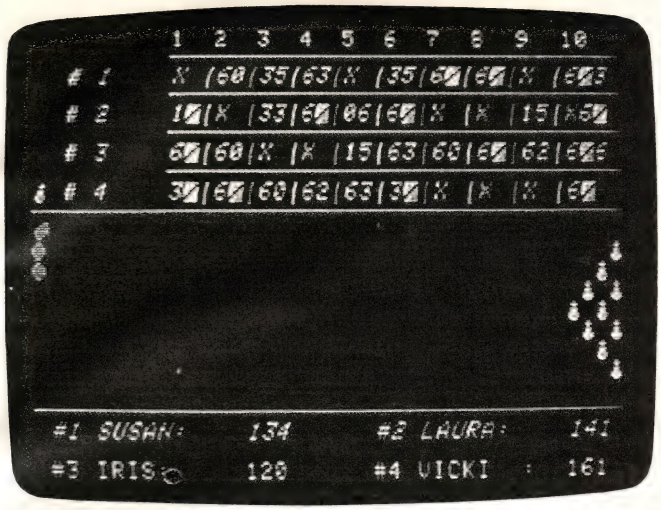
If some pins are left standing after your first ball, you get a second ball. If you knock down all the remaining pins, it counts as a spare, and the current ball's score is ten plus your next throw.

If any pins remain after your second ball (no strike or spare), the number of pins knocked down in that frame is added to your previous score.

Rolling a spare in the tenth (last) frame gains you one extra ball; rolling a strike in the tenth frame gains two extra balls.

Therefore, a perfect game—ten strikes during regular play plus two strikes with the extra balls—scores 300 points. Needless to say, this doesn't happen very often, either in real bowling or in Bowling Champ.

Since Bowling Champ follows every rule of scoring for regular bowling, you can learn how to score by carefully observing the game. The only



Four players compete in "Apple Bowling Champ": A blinking bowling pin next to a player's scorecard shows whose turn is next.

difference is that the computer does not wait until the end of a frame to update the score; it updates it after every ball.

Adjusting The Difficulty

Novice bowlers may find that the ball moves too fast for them to aim. On the other hand, more experienced players may want to speed up the ball to make the game harder. You can easily make either modification by changing the delay loop in line 480. The statement in 480 reads:

480 FOR R=1 TO 10:NEXT

Replacing the 10 with a larger number slows down the ball; a smaller number speeds up the ball. You might try a value between 20 and 50 for youngsters. For expert players, remove line 480 altogether.

Apple Bowling Champ

```
100  HIMEM: 36096: GOSUB 770
110  GOSUB 830: GOSUB 970
120  GOSUB 1160
130  HOME : POKE 230,32: CALL 62450: HGR
     : POKE 6,0: POKE 7,141: POKE 54,0:
      POKE 55,3: CALL 1002
140  GOSUB 1230
150  REM  -MAIN LOOP-
160  FOR Q = 1 TO 10: FOR Z9 = 0 TO A -
     1
170  FOR R = 1 TO 10: VTAB 2 * (Z9 + 1)
      + 1: HTAB 1: PRINT " ";: FOR F =
     1 TO 30: NEXT F: HTAB 1: PRINT "$"
     : FOR F = 1 TO 30: NEXT F: NEXT R
180 B1 = 0: GOSUB 360
190  IF J1 <  > 10 THEN B1 = 1: GOSUB 3
     90
200  IF Q = 10 THEN  ON S GOTO 210,270,
     270,210,310
210  VTAB (Z9 + 1) * 2 + 1: HTAB 1: PRINT
     " ": NEXT : NEXT : VTAB 24: HTAB 1
     0: POKE  - 16368,0: PRINT "PLAY AG
     AIN (Y/N)?";
220  IF  PEEK ( - 16384) < 128 THEN 220
230 K =  PEEK ( - 16384) - 128: IF K <
     > 78 AND K <  > 89 THEN  POKE  -
     16368,0: GOTO 220
240  IF K = 89 THEN 120
250  POKE  - 16368,0: HOME : TEXT : END
260  REM  -10TH FRAME : EXTRA BALLS-
270  VTAB 24: HTAB 5: PRINT "TAKE TWO M
     ORE BALLS, "NA$(Z9 + 1);".";
280  FOR I = 1 TO 2000: NEXT : VTAB 24:
      HTAB 5: PRINT  SPC( 30);
290 S(Z9) = S - 1:B1 = 1: GOSUB 360: IF
     J <  > 10 THEN 340
300  GOTO 330
310  VTAB 24: HTAB 5: PRINT "TAKE ONE M
     ORE BALL, "NA$(Z9 + 1);".";
320  FOR I = 1 TO 2000: NEXT : VTAB 24:
      HTAB 5: PRINT  SPC( 29);
330 S(Z9) = 1:B1 = 2: GOSUB 360: GOTO 2
     10
340 S(Z9) = 1:B1 = 2: GOSUB 390: GOTO 2
     10
350  REM  -FIRST BALL-
360  FOR I = 1 TO 10: VTAB A(I): HTAB B
     (I): PRINT "$": NEXT
370 PS = 1:J1 = 0: GOTO 400
380  REM  -SECOND BALL-
390 PS = 0
400  GOSUB 450:T = T(Z9):S = S(Z9):T =
     T + J
410  ON S(Z9) GOSUB 660,690,710,730,750
420 T(Z9) = T:S(Z9) = S
430  VTAB 21 + (A < 3) + 2 * (Z9 > 1) *
     (A > 2): HTAB 37 - (Z9 / 2 =  INT
     (Z9 / 2)) * 22: PRINT T(Z9): RETURN

440  REM  -ROLL BALL-
450 H = 1:C = 19:E = 11:D =  - 1: POKE
      - 16368,0
460  FOR V = C TO E STEP D: HTAB H: VTAB
     V: PRINT "*";
470  IF  PEEK ( - 16384) > 127 THEN T5 =
     V:V = E: NEXT : GOTO 510
480  FOR R = 1 TO 10: NEXT
490  HTAB H: PRINT " ";
500  NEXT V:D =  - D:T5 = C:C = E:E = T
     5: GOTO 460
510 V = T5: FOR H = 1 TO 35: HTAB H: VTAB
     V: PRINT " *";: FOR R = 1 TO 10: NEXT
     : NEXT
520 J = 0
530  IF ( SCRN( H,2 * (V - 1)) + 16 *  SCRN(
     H,2 * (V - 1) + 1) - 128) <  > 36 THEN
     570
540  POKE  - 16336,0:J = J + 1: FOR D =
      - 1 TO 1 STEP 2:X1 = V:X2 = H
550 X1 = X1 + D:X2 = X2 + 1: IF ( SCRN(
     X2,(X1 - 1) * 2) + 16 *  SCRN( X2,
     (X1 - 1) * 2 + 1) - 128) = 36 THEN
      HTAB X2 + 1: VTAB X1: PRINT " ";:
     J = J + 1: POKE  - 16336,0: GOTO 5
     50
560  NEXT
570  HTAB H: VTAB V: PRINT " *";:H = H +
     1: IF H < 40 THEN 530
580 J1 = J1 + J
590  VTAB 2 * Z9 + 3: HTAB 7 + 3 * Q +
     B1:G = J + 48
600  IF J1 <  > 10 THEN 630
610  IF PS THEN G = 88: GOTO 630
620 G = 47
```

```
630  PRINT  CHR$ (G)
640  HTAB H: VTAB V: PRINT " ";: RETURN
650  REM  -SCORING ROUTINES-
660  IF J1 <  > 10 THEN  RETURN
670  IF PS THEN S = 2: RETURN
680 S = 5: RETURN
690 T = T + J: IF J = 10 THEN S = 3: RETURN
700 S = 4: RETURN
710 T = T + J * 2: IF J <  > 10 THEN S =
    4
720  RETURN
730 T = T + J: IF J1 = 10 THEN S = 5: RETURN
740 S = 1: RETURN
750 T = T + J: IF J = 10 THEN S = 2: RETURN
760 S = 1: RETURN
770  DIM A(10),B(10): FOR I = 1 TO 10: READ
     A(I),B(I):X = X + A(I) + B(I): NEXT
     : IF X <  > 540 THEN  PRINT "ERROR
      IN DATA STATEMENTS FOR PIN POSITI
     ONS.": STOP
780  RETURN
790  REM  -PIN DATA-
800  DATA  12,40,13,39,14,38,14,40
810  DATA  15,37,15,39,16,38,16,40
820  DATA  17,39,18,40
830 X = 0: FOR I = 768 TO 852: READ A:X
     = X + A: POKE I,A: NEXT : IF X <
     > 7734 THEN  PRINT "ERROR IN DATA
     STATEMENTS FOR ML AT 768.": STOP
840  DATA  133,69,134,70,132,71,166,7
850  DATA  10,10,176,4,16,62,48,4
860  DATA  16,1,232,232,10,134,27,24
870  DATA  101,6,133,26,144,2,230,27
880  DATA  165,40,133,8,165,41,41,3
890  DATA  5,230,133,9,162,8,160,0
900  DATA  177,26,36,50,48,2,73,127
910  DATA  164,36,145,8,230,26,208,2
920  DATA  230,27,165,9,24,105,4,133
930  DATA  9,202,208,226,165,69,166,70
940  DATA  164,71,76,240,253
950  RETURN
960  REM  LOAD REDEFINED CHARACTERS
970 X = 0:AD = 36096: FOR L = 1 TO 16: READ
     B: FOR I = AD + B TO AD + B + 7: READ
     A:X = X + A: POKE I,A: NEXT :X = X
      + B: NEXT : IF X <  > 6223 THEN  PRINT
     "ERROR IN CHARACTER DATA STATEMENT
     S.": STOP
980  RETURN
990  DATA  0,0,0,0,0,0,0,0,0
1000  DATA  24,20,20,62,20,62,20,20,0
1010  DATA  32,8,28,8,28,28,62,62,28
1020  DATA  80,28,62,127,127,127,62,28,
     0
1030  DATA  120,63,31,79,103,115,121,12
     4,126
1040  DATA  128,28,34,50,42,38,34,28,0
1050  DATA  136,8,12,8,8,8,8,28,0
1060  DATA  144,28,34,32,24,4,2,62,0
1070  DATA  152,62,32,16,24,32,34,28,0
1080  DATA  160,16,24,20,18,62,16,16,0
1090  DATA  168,62,2,30,32,32,34,28,0
1100  DATA  176,56,4,2,30,34,34,28,0
1110  DATA  184,62,32,16,8,4,4,4,0
1120  DATA  192,28,34,34,28,34,34,28,0
1130  DATA  200,28,34,34,60,32,16,14,0
1140  DATA  448,34,34,20,8,20,34,34,0
1150  REM  TITLE SCREEN
1160  TEXT : HOME : VTAB 7: HTAB 12: PRINT
     "BOWLING CHAMP!": FOR I = 1 TO 4:N
     A$(I) = "": NEXT
1170  POKE  - 16368,0: VTAB 10: HTAB 7:
      PRINT "HOW MANY BOWLERS (1-4): ";
1180  IF  PEEK ( - 16384) < 128 THEN 11
     80
1190 A =  PEEK ( - 16384) - 128: IF A <
     49 OR A > 52 THEN 1160
1200  PRINT  CHR$ (A):A = A - 48: POKE
      - 16368,0: FOR I = 1 TO A: VTAB 1
     4 + I: HTAB 6: PRINT "BOWLER #"I"'
     S NAME: ";
1210  INPUT A$:NA$(I) =  LEFT$ (A$,8): NEXT
     : FOR I = 0 TO A - 1:T(I) = 0: NEXT
     : RETURN
1220  REM  DRAW GAME SCREEN
1230  VTAB 1: HTAB 10: PRINT "1  2  3
     4  5  6  7  8  9  10"
1240  HCOLOR= 3: HPLOT 63,11 TO 279,11
1250  FOR I = 1 TO A: VTAB 2 * I + 1: HTAB
     3: PRINT "# "I
1260  FOR J = 12 TO 36 STEP 3: HPLOT 7 *
     (J - 1) + 3,I * 2 * 8 TO 7 * (J -
     1) + 3,I * 2 * 8 + 8: NEXT
1270  HPLOT 63,2 * I * 8 + 11 TO 279,2 *
     I * 8 + 11: NEXT
1280  FOR I = 1 TO A STEP 2: VTAB 20 +
     (A < 3) + I: HTAB 1: PRINT " #"I"
     "NA$(I)":";: IF NA$(I + 1) <  > ""
      THEN  HTAB 23: PRINT " #"I + 1" "
     NA$(I + 1)":"
1290  NEXT I
1300  HPLOT 0,75 TO 279,75: HPLOT 0,155
      TO 279,155
1310  FOR I = 0 TO A - 1:S(I) = 1: NEXT
     : RETURN : REM  INITIALIZE SCORE S
     TATE
```

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Advanced Sound Effects On The 64

Philip I. Nelson, Assistant Technical Editor

Here are some secrets to creating unusual sound effects with the Commodore 64's built-in synthesizer chip. Using the accompanying program, you can experiment with different sounds without programming.

The Commodore 64's SID (Sound Interface Device) chip is capable of creating rich, extraordinarily complex sounds—but its power doesn't come without a price. There aren't any sound commands in Commodore BASIC, so everything must be done with POKEs. It's tedious to look up all those POKE values and easy to get sidetracked, since you must define several *parameters* (controlling values) to make even a simple sound. Many programmers, including professionals, grow frustrated and settle for crude beeps and whooping noises, wasting the 64's classiest sound features.

The program following this article is designed to help beginners learn about two of the 64's advanced sound effects: ring modulation and synchronization. It lets you produce a tone with two sound channels, and also switch either effect on and off just by pressing one of the 64's special function keys. Don't worry if the following explanations seem confusing at first; they'll make more sense after you've tried the program.

Independent Voices

Any sound can be visualized as a *waveform*, like the cross section of a ripple on a pond. The Commodore 64 is capable of reproducing four different waveforms. Three of them (the triangle, sawtooth, and pulse waves) produce clear tones, and the fourth (the noise wave) makes a rushing or hissing sound. Figure 1 represents each of these waveforms. You can assign any one of the four waveforms to any of the 64's three sound channels, or *voices*.

Each of the computer's three voices normally plays independently. That is, each voice sounds the same, no matter what the other two are doing. If you make voice 1 beep and voice 2 growl, voice 1 always makes the same beep even if you change voice 2's growl to a screech. For a simple analogy, picture each voice as playing through a separate channel, like the two channels on a home stereo system.

Ring modulation and synchronization go beyond this to create *interactive* effects, in which a parameter controlling one voice also affects the sound produced by a second voice. In both cases, the special effect is created by a difference in the frequencies (pitches) of the two voices.

Synchronization

Synchronization is the simpler of the two effects. You may picture it as mixing two voices in one channel so that their waveforms intermingle. The result is often a rhythmic or beating effect, produced as the peaks and valleys of the two waves move in and out of step with each other.

When the two waves are more nearly in step, their combined sound is more pronounced. When their peaks and valleys are more nearly opposed, they tend to cancel each other out, and the combined sound is quieter. Figure 2 shows a simplified diagram of both extremes. If you program both voices so their frequencies are always identical, synchronization produces no audible effect.

In addition to the original tones each waveform produces by itself, synchronization adds nonharmonic *overtones* (also called *sidebands*). The overtones are entirely new waveforms which would not exist without synchronization. For instance, imagine someone pounding a huge gong. Gong sounds are full of nonharmonic overtones, which are created as different areas of the big, flexible metal plate vibrate in and out of phase.

In simplest terms, synchronizing two voices gives you both original tones plus new overtones. However, the original tones predominate.

Ring Modulation

Ring modulation is a special type of synchronization in which overtones almost completely suppress the original tones. What you're left with is a sound composed chiefly of nonharmonic overtones. The results are often surprising and bear little if any resemblance to so-called natural sounds.

Used with care, ring modulation can produce haunting, beautiful effects. However, it works through a complex interaction of two waveforms, largely suppressing what you'd hear without the feature. So it can be difficult to handle if you don't know how it works in the first place.

Experimenting With Effects

Let's hear how these effects sound. Type in the program, save it, and type RUN. The program is set up with several default parameters, so to hear a quick example, just press RETURN at every prompt. The default parameters will be displayed in each case.

You should hear a flutey tone sweeping up the scale, over and over. To pause the tone during its upward sweep, press the CTRL key. (Don't worry about accidentally hitting the RUN/STOP key; it's been disabled.)

To switch on synchronization, press the f7 special function key. The f5 key switches on ring modulation, and the f3 key activates both effects at once.

When synchronization is selected, you'll hear the beating effect as the tone ascends in pitch and the two voices move in and out of phase with each other. Ring modulation creates a rich, spacey sound. Note that you can pause the tone with CTRL while pressing a function key. As you'll hear, the sounds are far less exciting when both frequencies remain fixed. The most interesting effects are made by changing parameters in realtime.

In these two-voice effects, one of the voices is called the *carrier*, and the other the *program* voice. These terms are derived from electronics, meaning that the first voice *carries* the signal (produces the basic sound), and the second voice *programs* (modulates) it. In this example program, voice 1 produces the carrier tone, and voice 3 programs voice 1.

In both synchronization and ring modulation, it is the *frequency* of the program voice which affects the carrier voice. The other program voice parameters have no effect on the carrier (of course, they will affect the program voice if it is turned on).

Shifting Frequencies

Now that you've heard these special effects with the program voice set for a fixed frequency, let's try changing the frequency while the tone is being produced. To raise the frequency of the program voice, press either SHIFT key. To lower it, press the Commodore logo key (next to the left SHIFT). The most pronounced effects are produced by decreasing the program frequency during a rising tone, and vice versa.

Now let's hear a descending tone. Press the f1 key to stop the sound, and enter the following values when prompted:

Rising/falling?	**F**
Carrier waveform	**T**
Program waveform	**(any waveform works)**
Hear program voice?	**N**
Program frequency	**9**
Starting frequency	**200**
Ending frequency	**5**
Loop rate	**6**

Experiment with the program for a while, trying out different parameters. For example, try producing the same sound with a smaller loop rate. Press f1 to enter edit mode, then press RETURN after the first seven prompts. Now enter .75 for the loop rate. Pressing RETURN at a prompt preserves the old value, so you need to type in only the parameters you want to change (however, you must always enter the loop rate for a falling tone).

When picking the waveforms, press T for a triangle wave, P for the pulse waveform, and so on. When you select a rising tone, the starting frequency must be smaller than the ending frequency. To create a falling tone, the first value must be larger than the second. If you make a mistake, use the DELete key to back up. The program signals an error if you enter illegal values. If you accidentally type in a letter when a number is required, the computer prints ?REDO FROM START. No harm is done; just enter the number you want.

The loop rate controls how fast the carrier frequency is changed as the tone moves up or down the scale. It corresponds to the STEP value in the FOR-NEXT loop that creates the tone (see lines 13–17). The smaller the loop rate (fractions are allowed), the slower the frequency will change, and vice versa. When the starting and ending frequencies are far apart, you can specify a large value for the loop rate; however, if you specify a starting frequency that is close to the ending frequency, you must keep the loop rate small to avoid causing an error in the program.

Programming Your Own Sounds

You can use this program to start building a library of sound effects. Just play around until you

find a sound you like, copy down the values from the screen, and plug them into your own program.

As you'll discover by experimenting, these special effects work well with certain combinations, and poorly (or not at all) with others. Ring modulation works only when you set the carrier voice to the triangle waveform. Synchronization works with any waveform, but synchronizing any frequency with the noise waveform (a nearly random combination of many frequencies) doesn't accomplish much. The sawtooth and pulse waves often sound similar.

Most of the time, you'll want to keep the program voice silent, using only its frequency to control the carrier (in which case its other parameters are irrelevant). However, you can press Y when prompted to hear the program voice. If you have trouble understanding how an effect works, try listening to the program voice for a while.

Ring modulation and synchronization are most pronounced when the program frequency is considerably lower than the carrier frequency and remains fixed, as in the above examples. Changing the program frequency to a higher fixed value makes the two voices move in and out of phase more rapidly. Run the last example, and change the program frequency from 9 to 22. Now select synchronization, and you'll hear a sharp, *meow-meow* sound.

Controlling Voices With Voices

You can use ring modulation or synchronization with any of the 64's three voices, but the voice relationships are fixed: voice 1 modulates voice 2, voice 2 modulates voice 3, and voice 3 modulates voice 1.

Thus, if you want to synchronize or ring modulate voice 1, you must use voice 3 as the program voice, and so on. Again, it is the frequency of the program voice which affects the result. This simple tutorial program uses only the high byte frequency register for each voice; of course, you can achieve much finer frequency control by using both the high and low bytes.

To select these special effects in BASIC, simply add 2, 4, or 6 to the normal POKE value for the waveform register of the voice you want to affect. For instance, POKE 54276,17 selects the triangle waveform for voice 1. POKE 54276,19 adds synchronization to the triangle wave (17+2=19). POKE 54276,21 enables a ring-modulated triangle wave; and POKE 54276,23 turns on both effects at once. Use POKE 54276,67 to select synchronization with the pulse waveform, and so forth.

Naturally, you can use these effects with more than one voice at a time. If you select synchronization in voices 1 and 3, then voice 1 will be affected by voice 3's frequency, and voice 3 will be affected by voice 2's frequency. However, because multivoice modulation creates so many overtones, it's easy for things to get out of hand. If you create a three-note musical chord with triangle waves in every voice, and then switch each to ring modulation, the result will be anything but musical.

Play with those frequencies for a while, though, and you'll find you can push the *overtones* into complex chords. Such chords have a ringing, live sound, and contain more than three notes. Interesting effects can also be created by tuning one or more voices slightly off-key.

Hints For Programmers

This program employs a few tricks you might find useful. Many programmers use a long series of individual POKEs to set up the SID chip at the beginning of a program. Line 1020 shows how to do this with a FOR-NEXT loop that READs the values from DATA statements and POKEs them into the SID chip. This makes your program easier for others to read and for you to modify. Note, however, that Commodore recommends POKEing attack/decay registers before waveform registers; the program follows this rule by POKEing the desired waveform values later on, in line 370.

To detect a single keypress, you can PEEK location 197 as we did in lines 14 and 15 (Z=197). Sometimes, however, you want to let the user do two things at once from the keyboard. In this program, for instance, you can select effects with a function key and simultaneously change the program frequency or pause the sound.

By PEEKing location 653, you can tell whether the CTRL, SHIFT, or Commodore logo key is pressed with another key (see line 16; Y=653). Location 653 holds the following values when the indicated key is pressed:

1 = SHIFT
2 = Commodore
4 = CTRL

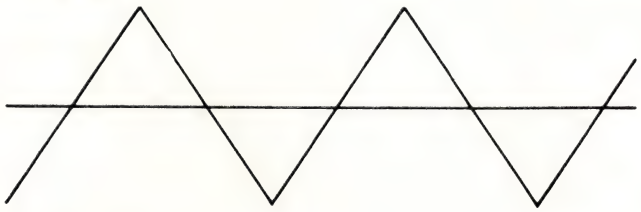
You can also detect combinations of these keys. Location 653 contains a 3 when both SHIFT and the Commodore key are pressed, 5 when SHIFT and CTRL are pressed, and so on. Checking for these keys gives you great flexibility in designing keyboard input. However, it's prudent to disable the RUN/STOP key when using them.

The program disables the RUN/STOP key in line 1010 with POKE 788,52. However, you can still exit the program by hitting RUN/STOP and RESTORE together. In the same line, POKE 657,128 prevents the computer from flipping the

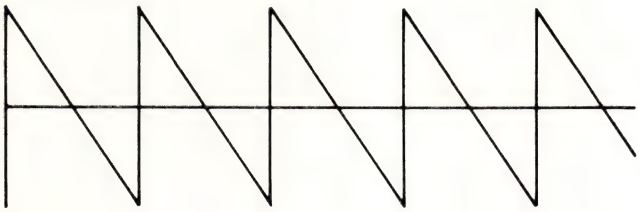
entire screen display from uppercase to lowercase if the SHIFT and Commodore keys are pressed simultaneously.

Figure 1: Commodore 64 Waveforms

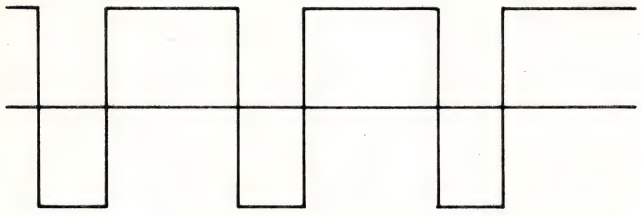
Triangle



Sawtooth



Pulse



Noise

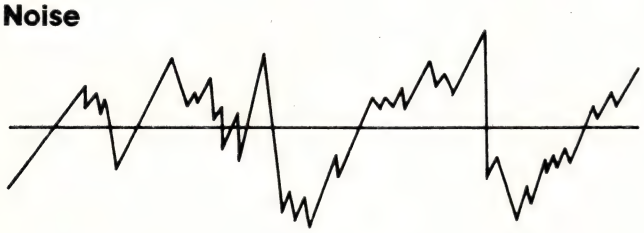
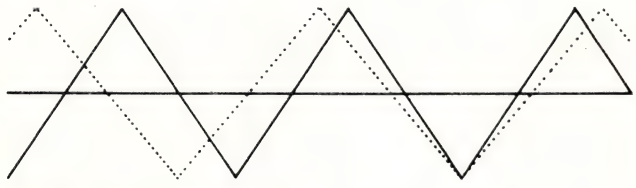
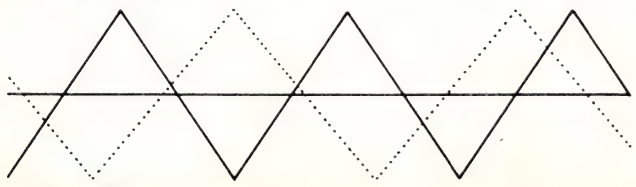


Figure 2: Synchronization

Waves nearly in step



Waves far out of step



Sound Effects Demonstrator

Please refer to "COMPUTE!'s Guide To Typing In Programs" before entering this listing.

```
1 GOSUB 1000:GOTO100                    :rem 118
2 PRINTCHR$(145)C$:FORJ=1TO400:NEXT:PRINT
  ER$CHR$(145):RETURN                    :rem 35
4 Z1=UN:ZZ=ED:RETURN                    :rem 109
5 ZZ=ZZ-LR:RETURN                       :rem 191
6 POKEW1,V1+TU:RETURN                   :rem 142
7 POKEW1,V1+FR:RETURN                   :rem 126
8 POKEW1,V1+SX:RETURN                   :rem 146
9 PF=PF+UN:IFPF>FFTHENPF=FF             :rem 39
10 RETURN                               :rem 65
11 PF=PF-UN:IFPF<UNTHENPF=UN            :rem 126
12 RETURN                               :rem 67
13 Z1=ZR:FORZZ=BGTOEDSTEPLR             :rem 121
14 IFPEEK(Z)=NNTHENPOKEW1,V1:GOTO16
                                        :rem 16
15 ONPEEK(Z)GOSUB10,10,6,4,8,7          :rem 202
16 ONPEEK(Y)GOSUB9,11,10,5               :rem 8
17 POKEH1,ZZ:POKEH3,PF:POKEBF,ZR:NEXT:IFZ
   1=UNTHEN19                           :rem 165
18 GOTO13                                :rem 6
19 POKEH1,ZR:POKEH3,ZR:POKEW1,ZR:POKEW3,Z
   R:POKE198,ZR                         :rem 29
100 PRINTFL$;:INPUTFF$                  :rem 137
110 IFFF$<>"R"ANDFF$<>"F"THENFF$="":GOSUB
    2:GOTO100                           :rem 184
120 PRINTUL$FF$:PRINTCV$;:INPUTVV$
                                        :rem 238
130 IFVV$<>"T"ANDVV$<>"S"ANDVV$<>"P"ANDVV
    $<>"N"THENGOSUB2:GOTO120             :rem 0
140 FORJ=1TO4:IFVV$=VL$(J)THENV1=VC(J)
                                        :rem 105
150 NEXT                                :rem 213
160 PRINTUL$VV$:PRINTPV$;:INPUTVW$:rem 32
170 IFVW$<>"T"ANDVW$<>"S"ANDVW$<>"P"ANDVW
    $<>"N"THENGOSUB2:GOTO160            :rem 12
180 FORJ=1TO4:IFVW$=VL$(J)THENV3=VC(J)
                                        :rem 112
190 NEXT                                :rem 217
200 PRINTUL$VW$:PRINTNF$;:INPUTYS$ :rem 9
210 IFYS$<>"Y"ANDYS$<>"N"THENGOSUB2:GOTO2
    00                                  :rem 158
220 IF YS$="N"THENV3=V3-UN               :rem 16
230 PRINTUL$YS$:PRINTPF$;:INPUTPF:rem 211
240 IFPF<UNORPF>FFTHENGOSUB2:GOTO230
                                        :rem 132
250 PRINTNL$PF:PRINTBG$;:INPUTBG :rem 122
260 IFBG<ZRORBG>FFTHENGOSUB2:GOTO250
                                        :rem 119
270 PRINTNL$BG:PRINTED$;:INPUTED :rem 111
280 IFED<ZRORBG=EDORED>FFTHENGOSUB2:GOTO2
    70                                  :rem 107
290 IFFF$="R"ANDED<BGTHENGOSUB2:GOTO270
                                        :rem 187
300 IFFF$="F"ANDED>BGTHENGOSUB2:GOTO270
                                        :rem 169
310 PRINTNL$ED:PRINTLR$;:INPUTLR :rem 148
320 IFLR<=ZRORLR>FFTHENGOSUB2:GOTO310
                                        :rem 216
330 IFFF$="R"ANDLR>ED-BGTHENGOSUB2:GOTO31
    0                                   :rem 126
340 IFFF$="F"ANDLR>BG-EDTHENGOSUB2:GOTO31
    0                                   :rem 115
350 IFFF$="F"THENLR=-LR                 :rem 115
360 PRINTNL$ABS(LR):PRINTCHR$(158)A$:PRIN
    TB$:PRINTF$:PRINTCHR$(158)A$   :rem 63
```

```
370 POKEH3,PF:POKEW1,V1:POKEW3,V3 :rem 82
380 GOTO13                        :rem 56
999 REM INITIALIZE                :rem 129
1000 PRINTCHR$(147)CHR$(5)CHR$(142):POKE5
     3281,0:POKE53280,0:Z=197:BF=198:Y=65
     3                            :rem 188
1010 POKE657,128:POKE788,52:S=54272:VM=S+
     24:FORJ=STOVM:POKEJ,0:NEXT   :rem 146
1020 FORJ=STOVM:READQ:POKEJ,Q:NEXT:rem 26
1025 FF$="R":BG=5:ED=125:LR=2:VV$="T":VW$
     ="T":PF=11:YS$="N"           :rem 102
1030 ZR=0:UN=1:TU=2:FR=4:SX=6:NN=64:FF=25
     5:H1=S+1:W1=S+4:H3=S+15:W3=S+18
                                  :rem 63
1040 R$=CHR$(18)                  :rem 51
1050 A$=R$+"{37 SPACES}"          :rem 77
1060 PRINTA$                      :rem 185
1070 PRINTR$"{4 SPACES}SOUND MODULATION D
     EMONSTRATOR{4 SPACES}"       :rem 54
1080 PRINTA$                      :rem 187
1090 B$=R$+CHR$(158)+" F7=SYNCH F5=RING F
     3=BOTH F1=RESTART "+CHR$(159)
                                  :rem 108
1095 F$=R$+CHR$(158)+" CTRL=PAUSE COM=FRE
     Q DN SHFT=FREQ UP "+CHR$(159)
                                  :rem 163
1100 C$=CHR$(158)+"{31 SPACES}"+R$+"ERROR
      "+CHR$(159)                 :rem 123
1105 ER$="{8 LEFT}{5 SPACES}"     :rem 235
1110 BL$=R$+CHR$(159)             :rem 68
1115 UL$=CHR$(145):FORJ=1TO31:UL$=UL$+CHR
     $(29):NEXT:UL$=UL$+"{2 SPACES}"
                                  :rem 104
1118 NL$=UL$+CHR$(157)            :rem 165
1120 FL$=BL$+" RISING OR FALLING TONE? (R
     ,F) "+CHR$(146)              :rem 228
1130 BG$=BL$+" STARTING FREQUENCY
     {4 SPACES}(0-255) "+CHR$(146):rem 80
1140 ED$=BL$+" ENDING FREQUENCY{6 SPACES}
     (0-255) "+CHR$(146)          :rem 154
1150 LR$=BL$+" LOOP RATE{13 SPACES}(1-255
     ) "+CHR$(146)                :rem 176
1160 CV$=BL$+" CARRIER WAVEFORM{4 SPACES}
     (T,S,P,N) "+CHR$(146)        :rem 132
1170 PV$=BL$+" PROGRAM WAVEFORM{4 SPACES}
     (T,S,P,N) "+CHR$(146)        :rem 162
1180 PF$=BL$+" PROGRAM FREQUENCY
     {5 SPACES}(1-255) "+CHR$(146):rem 15
1190 NF$=BL$+" HEAR PROGRAM VOICE?
     {5 SPACES}(Y,N) "+CHR$(146)  :rem 10
1200 FORJ=1TO4:READQ:VC(J)=Q:NEXT :rem 85
1210 FORJ=1TO4:READQ$:VL$(J)=Q$:NEXT
                                  :rem 203
1300 RETURN                       :rem 164
2000 DATA 5,0,128,7,0,15,240:REMVOICE1
                                  :rem 12
2010 DATA 0,0,0,0,0,0,0,0:REMVOICE2:rem 251
2020 DATA 5,0,128,7,0,15,240:REMVOICE3
                                  :rem 16
2030 DATA 0,0,0,15:REMFILTERS,VOLUME
                                  :rem 148
2040 DATA 17,33,65,129:REMWAVEFORMS
                                  :rem 17
2050 DATA T,S,P,N                 :rem 170 ©
```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Computers And Society

David D. Thornburg, Associate Editor

The Processed Word

My craft (such as it is) is writing. I write for a living, and I am able to live from my writing. I used to do other things for income, but when it comes right down to it, I am entranced by the power of words and by the ease with which two simple substances—paper and ink—can combine to form documents that can cause laughter, pain, joy, fear, and even boredom.

Pretty magical, this writing business.

Of course, as a writer, I have assembled a modest collection of writing tools—pads of paper, pens, typewriters, terminals, computers—the usual stuff.

One question writers ask from time to time is how their tools influence (dare I say determine?) what they write. Some critics argue, for example, that no great artistic works are going to be created on a word processor. These critics go on to suggest that the only good writing is done with tools like pencils, or perhaps typewriters.

In The Mind

These critics are confusing the tool with the result. The word processor will create no works of art at all. I use mine six hours a day, and it has yet to create anything of its own in its spare time. But then again, I don't expect my pens to create anything, and I am sure that our ancestors didn't expect wonders from sticks pressed into fresh mud, either.

Why the literary critics have missed the point eludes me. It probably comes from their own lack of exposure to a good word processing system. In fact, good writing takes place in the mind, not in the pen. I do my writing without ever lifting a pen, and then use whatever tool is at hand to transcribe this writing onto paper. Do my writing implements influence what I write? Perhaps they do, but only to a very small extent. (For example, I wouldn't be writing on this topic if I didn't use a word processor.)

As a writer, I have found that there are other factors that are much more influential than my choice of transcription tools. The first of these is exposure to good writing. I don't know any good writer who doesn't spend time reading other authors' books. Wherever I write, I have shelves lined with the works of others. Many of these books are technical and many are not. The shelf containing computer books also contains the works of Shakespeare. Aristotle shares shelf space with my Apple Logo manual. Exposure to good writing can be very important to an author—any author.

The second factor that I find as important as any other is having a good place to do my writing. I can write almost anywhere (on airplanes, for example), but my best writing comes when I am in a special place that is conducive to creative thought.

Each Its Own Charm

I am most fortunate to have three places that are conducive to writing. The first is a condominium high in the hills south of San Francisco. From my living room I can look into a verdant ravine, and trees fill my sight for as far as I can see. Further south, in an unused school in Mountain View, I have a rambling office that looks out on mulberry trees. The pitched roof of this office lends a certain resonance to the room when the winter rains beat against it. Inside, the spacious area has a warmth that encourages thoughts to flow. My third special place is in Monterey, in sight of the ocean. With wooded trails nearby, and miles of beach to explore, I find this area to be very encouraging to the creative process.

Each of these places has its own charm, but they all have one characteristic in common. In each of them I can find the quiet and solitude that seems to be important to me. When I am

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David Thornburg has used several word processors to write 11 books, including The KoalaPad Book, Computer Art and Animation *(a Logo book available in versions for the TI, Radio Shack, Atari, and Commodore computers), and* Exploring Logo Without a Computer *(published by Addison-Wesley). His whimsical look at computing (*101 Ways to Use a Macintosh*) has been published by Random House. Later this year, his first book on artificial intelligence applications in Logo (*Beyond Turtle Graphics*) will be published by Addison-Wesley. Thornburg welcomes letters from readers, but regrets that he is not able to answer all his mail. Correspondence should be sent to him in care of* COMPUTE!.

writing, I can tolerate no distractions—no background music, no telephones, no conversation—nothing, save for the sounds of the birds, or seals, or the rustle of the leaves, or the patter of the rain.

So if you ask me to identify my most important tools as a writer, they would be access to the writing of others, and a quiet place in which to write.

So what about the technology of transcription? Doesn't it have a role?

Of course it does—but its role is largely neutral or negative. What I mean is that I am rarely liberated by my writing instruments; I am often impeded by them. As a tinkerer I am forever buying new pens, papers, word processors, and other tools, looking for ways to facilitate transcription. This is a highly personal quest. Some writers can dictate their manuscripts into a tape recorder. I cannot. Some writers prefer to use only No. 2 pencils and yellow legal pads. I do not.

The point is that there is no one best transcription tool, just as there is no one best writing style, or one best author.

While my use of tools changes from time to time, my process for transcribing a manuscript is roughly the following:

My first draft is often (but not always) written in longhand with a (gasp!) cheap fountain pen in a blank book or legal pad. I persist in using a fountain pen because I like the feel of it gliding along the paper. I don't like changing ink cartridges, but I tolerate this inconvenience.

Flubs, Snags

Why, in this age of computers, do I horse around with buggy whip technology? There are several reasons. First, I need to use a highly portable writing medium since I don't always know where I am going to be when I will want to write something. Second—and more important—the written page is not a page of pure text. It is a graphic document as well. Words can be underlined, crossed out, and added in the margins. Ideas for later parts of the document can be jotted down in the middle of a page and circled to show that they are part of something else.

As I am writing the document, I turn off all conscious judgment. Spelling errors, grammatical flubs, syntactic snags, all these go unnoticed at this stage. All I want to do is transcribe my thoughts. Period.

Once the document is captured on paper, I usually review it once, and make any large changes that come to mind. Next, I transcribe my writing into a computer system, either by entering it into my word processor directly, or by first entering it into a portable computer that accompanies me when I am on the road.

Both my portable (Radio Shack Model 100) and desktop (Apple Macintosh with *MacWrite*) computers have intuitively simple, virtually modeless, word processors. Because of what I do as I transcribe my handwritten text into the computer, it is important that the word processor be intuitively easy to operate.

In fact, I have a cardinal rule regarding word processor selection. I refuse to use a word processor whose manual is larger than the document I want to create. Since I am not in the process of compiling an encyclopedia, I have yet to work with *WordStar*.

The Product, Not The Tool

The task of transcription to the computer is one I undertake myself. I can't delegate it to a secretary because this transcription process is another chance to refine what I have written. By the time my document is in the computer, all that remains is to check the spelling and make grammatical corrections.

From creation to preparation of a final manuscript, I usually use several writing tools. I ask something different from each of them—but I am flexible. I sometimes capture my ideas with a keyboard instead of a pen, and the results are fine.

As with so many other areas of technology, we need to separate the tool from the product. The writing product can be produced in many ways, and it is the function of our tools to make these ways as easy to use as possible.

A Secret Process

In fact, there are many advantages to using a word processor over a typewriter. One of the beauties of using a word processor is that it lets you prepare a letter-perfect document. I find that my writing is better when the document looks nice. In this regard, the word processor helps me to be a better writer.

On the flip side of this argument, writers who use word processors tend not to retain copies of earlier drafts. There may be some scribbled notes and a final manuscript, with no documentary evidence of the process by which one became transformed into the other. Scholars who are interested in exploring the development of a book will have a harder time as today's Hemingways create intermediate drafts that are edited rather than rewritten.

But this shouldn't influence the quality of the author's writing—it only keeps the process a secret.

Maybe this makes writing a bit more magical!

©

Donald B. Trivette

Inside *King's Quest*

Byron and I were playing *King's Quest*—a new adventure game for the IBM PCjr written by Sierra. "But how does it work?" he wanted to know. "How would you even go about writing a program like that?" As a bright computer science major, Byron can write programs to perform reverse Polish notation, link-lists in Pascal, and all those other exotic things that students learn to do. But he couldn't begin to guess how *King's Quest* was written. Neither could I.

Everyone is familiar with arcade-style games in which you win points either for zapping strange-looking creatures or for not getting zapped yourself. An adventure game is entirely different. Winning an adventure game requires logic and puzzle-solving ability, not eye-hand coordination with a joystick.

Searching For Treasure

In *King's Quest* you play the game as Sir Grahame, a computer-animated knight who roams the kingdom of Daventry looking for three treasures. As Sir Grahame explores the kingdom, he can pick up objects like a dagger, a carrot, and a goat (yes! a goat) that may eventually help him locate the magical treasures. However, finding the objects is no cinch—some are in plain view but easily overlooked, while others are hidden in stumps and at the tops of trees. And of course there are hazards to overcome and puzzles to solve. How can Sir Grahame get across a bridge guarded by a troll? Kill the troll with the dagger? Don't try it! This is a game of strategy, *not* violence. There are several solutions to each puzzle and the more innovative and peaceful Sir Grahame is, the more points he gets.

The mechanics of playing the game are simple. You control Sir Grahame with either a joystick or the cursor-arrow keys. When Sir Grahame moves out of one scene, say to the right, a new scene appears on the screen. The main kingdom of Daventry is six scenes from north to south and eight scenes from east to west. The kingdom wraps around itself so that the 48 scenes are continuous. There are 32 other scenes for the interiors of caves and houses.

On the bottom four lines of the screen, you can type simple verb-noun sentences like *Take a carrot*, *Kill the troll*, or *Look at the river*. This area also displays messages and warnings for Sir Grahame: *The river is swift and deep*. (One quickly learns not to swim in swift, deep rivers.)

The graphics and animation in the PCjr version of *King's Quest* are spectacularly better than in any other adventure game I've seen. The three-dimensional quality makes it seem like Sir Grahame is moving through an animated cartoon. He can bump into and go around objects, climb trees and swim in water, duck behind rocks, and jump into the air. If he walks behind a rock, his legs are invisible; if he walks in front of a rock, part of the rock is invisible. When Sir Grahame moves, his arms and legs move, and the background shows between them. While we take that kind of animation for granted in a movie, it is not easily accomplished in a computer program on a machine without sprites. That's the part that had Byron and me puzzled. *How do they do that?* I called Sierra to find out.

A $700,000 Computer Game

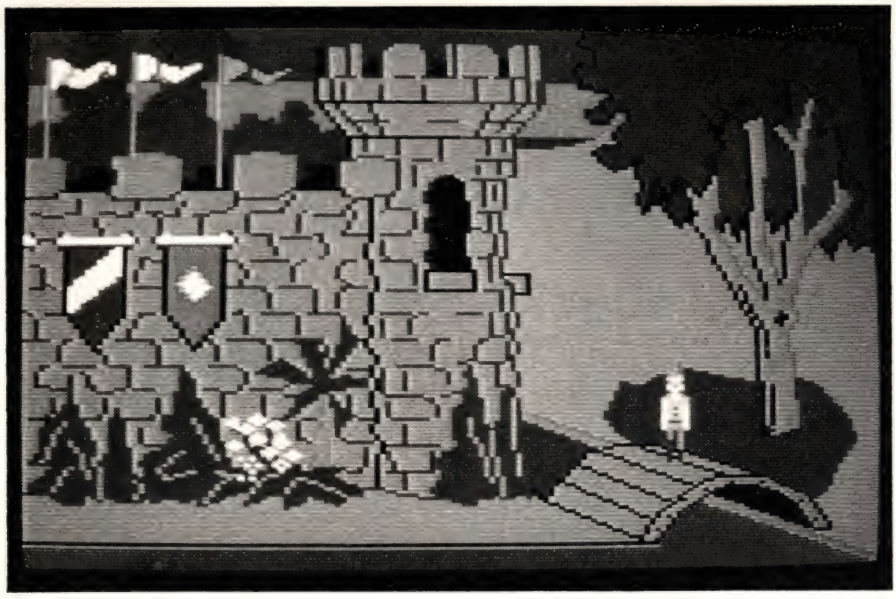
A year before the PCjr was announced—when the "Peanut" was just a rumor to the rest of us—IBM asked Sierra to create a game that would show off the new computer's color graphics capabilities. IBM supplied Sierra with a prototype Junior.

Roberta Williams, who had worked on five other adventure games, was given the task of designing something completely new and different. Eighteen months later, Williams and a team of six programmers and artists had created *King's Quest*—at a cost of over $700,000.

First, Williams wrote the story. She based it not on strange characters with strange names, but rather on familiar characters from literature.

Do you remember "Billy Goats Gruff" and "Hansel and Gretel"? Once the story line was established, the artists prepared detailed color drawings of each of the 80 scenes. In adventure-game jargon, scenes are called *rooms*. Each drawing was then traced on a Calcomp Graphics Tablet. This process automatically generated the instructions which tell the computer how to reproduce each room, saving the programmers months of tedious work.

The drawing instructions for each room are stored as separate files on the disk. (Technically, they are stored at absolute sector addresses, not actually in disk files.) When Sir Grahame moves from one room to another, the computer loads the instructions for displaying the new room, draws the room point by point, and then fills in the color. It takes about four seconds for the PCjr to draw and color a room. A faster approach would have been to store the room *images* themselves on disk, already drawn. But that method would have used considerably more disk space and reduced the number of rooms in the game. (Actually, it's entertaining to watch the computer draw and color each scene.)



Sir Grahame begins his quest at the castle of Daventry.

The Invisible Skeleton

The first scene in *King's Quest* is the castle of Daventry where Sir Grahame's quest begins (see photo). The lions, flags, stone blocks, alligators, and plants make this the most detailed room in the kingdom. It takes 2400 bytes of instructions to tell the PCjr how to draw and color this scene. By contrast, the easiest room to draw requires only 470 bytes of instructions.

The scenes are more than just static backgrounds. For instance, if Sir Grahame staggers a bit and runs into a castle wall, he stops. How does the program know when the character hits something? There's a skeleton, an invisible structure, behind each picture. If you could see this skeleton, you'd notice lots of lines running all over the screen defining where Sir Grahame can and cannot walk. The lines were drawn into each room with the graphics tablet.

In addition to concealing hidden lines, each room also assigns priorities to every object it contains (trees, rocks, flowers, etc.). These priorities—numbers from 1 to 15—give *King's Quest* its three-dimensional quality.

Objects at the top of the screen have low priority; those at the bottom, high. Sir Grahame's priority changes as he moves around the room. For example, a tree in the middle of the screen might have a priority of 9. When Sir Grahame is in front of the tree—closer to the bottom of the screen—his priority might be 11. As he moves up the screen, his priority changes. If he is behind the tree in a scene, his priority is less than that of the tree. By comparing priorities each time Sir Grahame moves, the program makes decisions about how to draw the screen. If Sir Grahame's priority is higher than the object behind him, he is visible and the object (or part of it) is invisible. If his priority is lower, as when he steps *behind* a tree, then he (or part of him) disappears.

Each time Sir Grahame (or any object) moves, the surrounding region on the screen is saved in the computer's memory in one of four *save-areas*. The program checks the new location for skeleton lines and priorities, then adjusts Sir Grahame and the surrounding area for any changes—perhaps part of a rock became visible in front of his legs. Finally, Sir Grahame and the surrounding area are redrawn on the screen. And that's how Sir Grahame walks around the kingdom of Daventry.

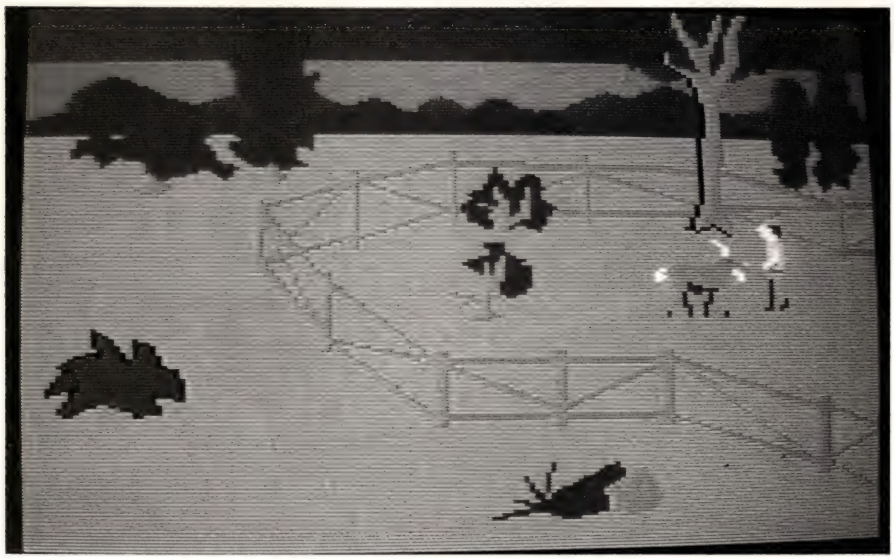
The Game's Own Language

In addition to the graphics for each room, there is a set of logical statements. These are written in a special language devised by Sierra called the Game Adaptation Language. The program constantly loops through these statements looking for something to change. They work sort of like a group of IF-THEN statements in BASIC.

For example, in one room, room 10, a goat randomly wanders around inside a pen (see photo). The pen extends into room number 11 on the right. If the goat happens to wander out of room 10, the program must erase the goat. The program knows the goat by the codename *14* and Sir Grahame by the name *Ego*. So if Ego moves to room 11 in search of the goat, the program must remember to draw 14 in room 11. The statement in Game Adaptation Language looks like this:

IF HAS-GOAT 0 AND OBJHIT-EDGE 14 AND EDGEOBJ-HIT 1 AND GOAT-GONE 0 AND SHOW-CARROT 0 THEN ASSIGN GOAT-ROOM 11, ERASE 14.

If I understood what that meant, I'd be writing adventure games instead of magazine articles, but with a little examination we can pretty much figure out what's going on. In programming logic, the numeral 0 means *false, no,* or *off,* and the numeral 1 means *true, yes,* or *on.* Thus, in English, the statement might read: "If Ego doesn't have the goat and if the goat has hit the edge of the room and if the edge of the room has been hit and if the goat is in the room in the first place and if the goat has not been shown the carrot, then [Whew!] remember to draw the goat in room 11 and erase the goat from room 10."



A pastoral scene in King's Quest.

And remember, that is just one of the logic statements that goes with room 10—there are a total of 180 logic lines for this room alone. The logic statements give the program its personality; they tell the program what to do and when to do it.

Inevitable Bugs

Anyone who has ever written a computer program knows that program logic is a fertile field for errors. If the programmer forgets to tell the computer just one little detail, the results can be amusing—and disastrous. Preliminary versions of *King's Quest* were not without bugs. It took several weeks to find out why, if Sir Grahame jumped in the air as he moved from one room to another, he skidded into the new room totally out of control. That bug has been fixed, but a few others still lurk in the current PCjr version. (But not, says Sierra, in the versions it markets directly.)

During one game, Sir Grahame was standing at the edge of a bridge. The goat was coming back across the bridge, and as it passed, I made Sir Grahame jump. A foolish thing to do, I know, but I was celebrating. Unfortunately, the screen filled with horizontal lines and the game came to a swift end. The programmer who wrote the logic statements for that scene forgot to allow for the possibility that Ego might jump as the 14 passes in front of him. Nevertheless, the errors are very few.

Some things you might consider an error are not errors at all. For example, there can be only four animated objects (including Sir Grahame) in any one room. The program has only four *save-areas* for animated objects. Somewhere along the way (I won't tell you where), Sir Grahame can acquire some magic beans. Getting those beans is the toughest part of *King's Quest.* (It helps to have read *Grimms' Fairy Tales.*) But try to plant the beans in the room where you found them and the screen will say: "You can't do that here." That's because *that* room already has four animated objects. In fact, you can plant the beans in only about half of the rooms in *King's Quest* because of the four-object-maximum rule. That's not a bug or an error, it's just a programming tradeoff to conserve memory.

There *is* one room in *King's Quest* with five objects. I don't want to give anything away, but: Should Sir Grahame (1) give the Woodcutter (2) and his wife (3) the right object (4), then he can take the fiddle (5). This apparent violation of the rule is permitted because the programmers pulled a fast one. Look closely when Sir Grahame puts *the something* on the table and you'll see the Woodcutter disappear for a moment. The programmer briefly swaps objects to keep within the limits. Tricky.

A Sequel On The Way

Roberta Williams is a perfectionist. There just wasn't time or memory to put everything in *King's Quest* that she wanted. She wishes the language interpreter had a larger vocabulary, that Sir Grahame could drop objects he has picked up, and that he could be even more animated. She wishes some of the characters, like the wolf, could roam from room to room. But she says the sequel, due in February or March, will be even better.

In *King's Quest II*, Sir Grahame—who becomes King Grahame when you solve *King's Quest*—goes in search of a wife. Along the way he meets Dracula and King Neptune, and rides a flying carpet. And, somehow, the folks at Sierra found a way to squeeze 94 rooms onto the disk. I can hardly wait.

IBM markets the PCjr version of *King's Quest* and Sierra markets versions for the IBM PC, Apple IIc, Apple IIe, and Tandy 1000 (a new computer scheduled for release in January 1985). All versions cost $49 and require 128K of memory and a disk drive. In addition, the PC version runs on most IBM compatibles. (When the PC version is displayed on an RGB monitor, the graphics are in the standard four-color medium-resolution mode; but connect your PC to a television and you'll get the same spectacular colors as the PCjr version.) ©

INSIGHT: Atari

Bill Wilkinson

I am much gratified by the response to my decision to work harder on answering readers' questions. I have received several *very* interesting letters with both good comments and good questions. Since it is always fun to defend Atari BASIC against the outside world, let me start with a subject near and dear to my heart.

Benchmarks

Several readers have asked me why Atari BASIC compares so unfavorably to other computers on certain benchmarks. The two most commonly mentioned are the *BYTE* magazine benchmarks and the *Creative Computing* benchmark invented by David Ahl. Stan Smith, of Los Angeles, asked some very pointed questions, which I will try to answer here.

The *BYTE* benchmark is reproduced below in Atari BASIC. It is the often-mentioned "Sieve of Erastothenes," a program which produces (and counts) prime numbers. Its primary advantage as a benchmark is that it can be implemented in virtually any language (although only with much difficulty when using Logo and its ilk). It relies only on addition and logical choices, with very little number crunching.

```
10 DIM N$(8192)
20 N$="0":N$(8192)="0":N$(2,819
   2)=N$
30 FOR I=1 TO 8192:IF N$(I,I)="
   1" THEN 60
40 PRIME=I+I+1:CNT=CNT+1:K=I
50 K=K+PRIME:IF K<8193 THEN N$(
   K,K)="1":GOTO 50
60 NEXT I
70 PRINT CNT : REM BETTER PRINT
    1899!!!
```

An aside: If you have seen the *BYTE* original and are puzzled by my changes, be aware of three things: (1) I had to use a string because there is not enough room for an array of 8192 elements. (2) The math was modified very slightly to accommodate the fact that string indices start at one, instead of zero. (3) Multiple statements per line simplify the original somewhat.

Anyway, why is Atari BASIC so slow (317 seconds versus, for example, the IBM PC at 194 seconds)? Primarily for three reasons. First, note

all the numbers in this listing, which must be treated as integers. Line numbers and indices are always kept and calculated as floating-point numbers, but all must be converted to integers before being used. (You simply can't GOTO line 137.38, can you?) And, sigh, the routine in the Atari Operating System ROMs which converts numbers to integers is incredibly slow (in fact, it is the only floating-point routine we modified when we produced BASIC A+ and BASIC XL).

Second, Atari BASIC performs FOR-NEXT loops by remembering the line number of the FOR statement. Then, when NEXT is encountered, BASIC must search for the FOR line, just as if a GOTO had been used. (Other BASICs remember the actual memory address of the FOR statement. Faster, but less flexible. Atari BASIC allows you to STOP in the middle of a loop, change the program, *and continue*, something no other home computer BASIC allows. (This—among many other things—is in direct opposition to *Consumer Reports'* claim that Atari BASIC is hard for beginners.)

Third, if you type in and use this listing as shown, you are paying almost a 50 percent penalty in speed, thanks to Atari's screen DMA and Vertical Blank Interrupts taking up a significant portion of the processing time. The simple addition of the following two lines will improve the time for this little test to 211 seconds:

```
5  POKE 54286,0 : POKE 54272,0
65 POKE 54286,64
```

All of a sudden, Atari BASIC isn't even *near* the bottom of the list. And, yet, there is more we can do to improve the machine's performance. As many have suggested, you can install the Newell Fastchip, a replacement for the floating-point routines built into your computer (available from many dealers, produced by Newell Industries of Plano, Texas).

Or you can change to another BASIC. Obviously, there is Atari's Microsoft BASIC. It produces results very close to those of Applesoft; but it, too, can be improved by turning off screen DMA, etc. And there is OSS's own BASIC XL. Using a combination of clever programming and a Fastchip, the BASIC XL program below will count up all those prime numbers in 58.5 seconds, about three times as fast as Microsoft BASIC on an IBM PC can do it. 'Nuff said. (Except a P.S.: The Set 3 in line 10 requests zero-time FOR loops, something not available in many BASICs, which alone accounts for about 20 seconds worth of improvement.)

```
10 FAST: POKE 54286,0: POKE 542
   72,0: SET 3,1: DIM N$(8192):
    N=ADR(N$)
30 FOR I=0 TO 8191
50 IF NOT PEEK(N+I) THEN PRIME=
   I+I+3: CNT=CNT+1: FOR K=I+PR
   IME TO 8191 STEP PRIME: POKE
    N+K,1: NEXT K
60 NEXT I
70 POKE 54286,64: POKE 559,34:
   PRINT CNT
```

Measures Of Accuracy

The Ahl benchmark is listed below. It purports to measure both accuracy and number-crunching ability. It does neither very well. Still, we have to ask why Atari BASIC is near dead last in its rankings, requiring 6 minutes and 45 seconds to complete the test.

```
10 FOR N=1 TO 100: A=N
20 FOR I=1 TO 10: A=SQR(A): R=R
   +RND(0): NEXT I
30 FOR I=1 TO 10: A=A^2: R=R+RN
   D(0): NEXT I
40 S=S+A: NEXT N
50 PRINT "ACCURACY="; ABS(1010-
   S/5), "RANDOM="; ABS(1000-R)
```

The culprit here (in terms of time-wasting) is line 30, with its A=A^2. Atari BASIC, in common with most small computer BASICs, calculates powers according to a formula:

x^y = exp (y * log(x))

where log() is the natural logarithm function and exp() is the exponent-of-e function.

If you don't understand that, don't worry about it. The point is that the calculation of such a simple thing as a number to the second power involves the calculation of a logarithm and an exponentiation. And why is that so bad? Simply because the floating-point routines in the Atari OS ROMs are too slow. Again, the solution is to install the Newell Fastchip and/or turn off DMA and VBI (as outlined above).

I am indebted to Clyde Spencer, one of the founders of the Bay Area Atari Users Group (one of the oldest), for supplying me with a most surprising figure. Spencer reports that, using the Fastchip and with DMA turned off, he obtained a timing of 1 minute 38 seconds, a very respectable (albeit not record-shattering) performance. I still wouldn't use my Atari for advanced scientific applications, but it is more than adequate for most purposes.

There is a problem with the "accuracy" figures in this test, however. First, because Ahl's accuracy number is the result of 1000 simple sums, it is clearly possible that a particular machine may exhibit wildly variant results for various numbers and still show a good figure in his test. (To illustrate, assume that the SQR() function randomly tosses in an error of plus or minus

one. If it tossed in an equal number of errors, they would balance to zero. Yet choosing to make the loop just one unit shorter [FOR N=1 TO 999] might give a completely different result. To be fair, this is a very unlikely result with modern math algorithms; but, still, one never knows.) A minor change to his program would improve the testing qualities considerably:

```
40 S = S + ABS( A-N ) : NEXT N
```

Do you see the difference? This method produces the sum of the errors, and doesn't fall prey to offsetting errors.

The Random Number Trap

There is no hope for the accuracy of this random number tester, though. I will quote Clyde Spencer on this matter: "If the numbers are *truly* random and *not* normally distributed, *any* difference between 0 and 1000 is possible. All you can say is that you would have a high *probability* of . . . being near zero for a perfect random number generator." The benchmark test falls into the infamous BASIC repeating-random-sequence trap.

In most BASICs, when you command a program to run, the pseudorandom generator is *always* reseeded with the *same* number. So each and every time you will get the same results, with Ahl's test. And, depending on what seed is chosen, you may get truly phenomenal results (because you happened to hit a hot spot in the generator's sequence). Now, though, try starting the generator off with a different (and randomly chosen) seed each time. What happens? The test's randomness figure wanders all over the place.

Once again, to quote Spencer, " . . . in eight tests I obtained numbers ranging from 1.6 to 24.2, with the mean being 7.02 . . . . "

Finally, I would like to point out that Ahl's test penalizes small machine BASIC interpreters in yet another way: When you have 32K bytes to spend on a BASIC, one thing you do is insure that numbers to a power are performed by successive multiplications, if possible. Thus Cromemco 32K Structured BASIC (for example) performs A^2 with just one multiply. In other words, it converts A^2 to A*A. If you manually substitute that same form in Ahl's program, the times for almost all of the smaller and less expensive machines will improve dramatically. (Surprisingly, though, the accuracy figures may not change. After all, the original version may have had offsetting errors.) Of course, if you need to use noninteger powers in your programs, this comment doesn't apply, and the benchmark's results are a bit more meaningful for you.

Well, what does all this long-winded discussion boil down to? Two simple points: (1) Always presume that a benchmark program is worth slightly less than the paper it is printed on. (2) If you want to do number crunching on your Atari computer (against my best advice), go out and buy the Newell Fastchip. (And it won't hurt to try some other languages.)

HELP? HELP!

Besides noting that GRAPHICS 15 on the XL machines is easily accessible (it's equivalent to mode 7½ on older machines), Mark Butler, of Antioch, California, asked for some information about the HELP key.

Simply put, pushing the HELP key on an XL machine causes an interrupt (I'm not sure which one) that, in turn, causes the Operating System to set a HELP flag. The magic location is $2DC, 732 decimal. Pushing HELP, either alone or in combination with CONTROL or SHIFT, forces the OS to put a value here, as shown below:

Key(s) Pressed	Value in $2DC (732)
HELP alone	$11 (17 decimal)
CONTROL+HELP	$91 (145)
SHIFT+HELP	$41 (65)

To use $2DC, you must POKE it back to zero after you have decided that someone needs HELP which you are going to act on.

Butler also requested a program which would, for example, print out an error message for the last BASIC error number when the HELP key is pressed. While not a *really* difficult project, it is a bit too heavy for this column. On the other hand, it would be trivial to add a HELP capability to many BASIC programs. Why not try it?

As long as we are on this subject, I would like to also note the effects of the 1200XL's function keys on another memory location, $2F2 (754 decimal). The various possible values are listed below. Note that CONTROL used with a function key is not generally accessible after keyboard input, since these combinations have special meanings to the OS and the editor handler. We will thus ignore them here.

Key(s) Pressed	Value in $2F2 (754)
F1 alone	$03 (3 decimal)
SHIFT+F1	$43 (67)
F2 alone	$04 (4)
SHIFT+F2	$44 (68)
F3 alone	$13 (19)
SHIFT+F3	$53 (83)
F4 alone	$14 (20)
SHIFT+F4	$54 (84)

Too bad all machines don't have function keys, isn't it?

Cassettes And The XL Machines

Guy Servais, of Norfolk, Virginia, was one of several who I inadvertently ignored when I discussed holding down the OPTION key while

booting an 800XL computer. My apologies for slighting you cassette owners.

Still, my general comments apply: If you purchase a cassette program which includes instructions telling you to remove your BASIC cartridge, you *must* hold down the OPTION key while booting that cassette. The kicker here, though, is that you must *also* hold down the START button to force the boot in the first place. Under the conditions mentioned, I recommend holding down *both* buttons until you actually hear the tone on the tape being accepted by the computer.

Servais also asked me if you can "disable the built-in BASIC . . . and can type in programs written in machine language." I can only presume that he has either seen or used other brands of computers which have some sort of minimonitor which allows you to access the bits and bytes of memory. (For example, Apple II computers have a small monitor which you can get to.)

Sorry, Guy, but there ain't no such thing on an Atari computer. You have three choices:

1. Use BASIC. This isn't quite as bad as it sounds. Look at the MLX machine language loader which COMPUTE! uses. It is a good tool for entering machine language written by others.

2. Buy a cartridge-based assembler. The old Atari *Assembler Editor* cartridge is often available at a substantial discount. It's not great, but it's much better than the simple monitors on other machines.

3. Buy a disk drive. This will open up a whole new vista in machine language. There are several appropriate assemblers for disk users.

Even though I have said this before, it bears repeating: The *first* peripheral you should buy is a disk drive. Only use cassette if you are desperate, and never waste your money on a printer until you have a disk.

Can You Help?

Servais mentioned one more thing in his letter which disturbed me. He is experiencing the infamous Atari BASIC editing lockup in his 800XL with the built-in BASIC. I had believed that the 800XL's BASIC had cured that problem (though it left a few other bugs lying around). Now, truthfully, I haven't used much besides BASIC XL in the last year, so I have not been aware of this problem at all.

Has anyone documented the circumstances under which lockup occurs? Please write and tell us. Once again, since BASIC is in ROM, I doubt there is a fix for the problem. But if we are aware of why and how it occurs, we may be able to warn others away from those conditions. ©

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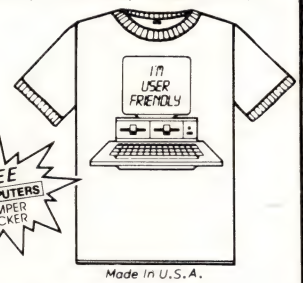

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TELECOMPUTING TODAY

Arlan R. Levitan

I work full-time in the IBM support district of a large telecommunications utility. About two weeks ago I was informed that my request to attend a one-week conference sponsored by IBM in San Francisco had been approved. Now, I don't particularly care for flying, especially a five-hour flight to the West Coast. Besides, the corporate travel bureau we use always has had a habit of routing me to my destination with three-hour stopovers in backwater airports and plane changes that would give Colonel Chuck Yeager fits.

I decided to try a feature offered by most of the commercial information services, an electronic edition of the Official Airline Guide (OAG). A few words of explanation are in order for those of you unfamiliar with the OAG. The regular paper edition of the guide is printed once every two weeks and contains fare and schedule listings for all of the commercial airlines in the United States. It is theoretically available to regular travelers at little or no charge. Actually, getting a recent copy from an airline or travel agent usually requires giving up a complete set of fingerprints and your first-born child.

The electronic edition of OAG, while not free, does have some advantages. Its on-line information is always current and, most important, it offers extensive search capabilities. Using the electronic OAG, it's a snap to find the lowest possible fares available, even ones that many travel agents can miss. Sure, I could have called around to every airline in town and got the same information for free. But "free" in this case means spending about an hour making ten or so phone calls, plus being subjected to canned Muzak while waiting for a reservations operator.

Looking up the flights via the electronic OAG took around 90 seconds and cost about $1.50. Besides, it was a lot of fun to call the airline I had settled on and have all of the flight information before the fact. Electronic OAG will really come into its own when the information services also offer on-line ticket bookings for all airlines. Don't be surprised if such services are commonly available by the end of the year.

Telecomputing On The Run

Two days before I was to leave, I got a call from my editor at COMPUTE!.

"Arlan, this is Tom. Where's the February column?"

"Are you kidding? I just sent January two weeks ago, and I'll never live down the fact that it was actually on time. Besides, I'm going to be out of town for a week. There's no way I can get it to you by next week." I smiled, thinking of leisurely strolling along Fisherman's Wharf in the cool of a San Francisco evening.

"Hey, didn't you just buy a lap computer with a built-in modem? You can take it with you, write the column on it and then transmit it directly into our computer via phone, right?"

I silently cursed myself for ever mentioning my new acquisition in passing conversation.

Actually, taking a modem on the run turned out to be a pretty good idea. The Sunday I arrived, it was raining heavily, and I was too jet-lagged to want to go anywhere. Having a portable computer with a modem saved me from having to endure *Knight Rider.* From the comfort of my hotel room, I logged onto my favorite commercial information services, chatted with some of my electronic compadres, and perused items of interest on the various forums I participate in.

Monday night, I left a message on a local computerized bulletin board system (BBS) asking for restaurant recommendations from the locals, rather than trust the "Dine At Our Advertisers" booklets that litter hotels.

Wednesday, I received a call from my place of work in Michigan. There was a minor problem with one of the computer subsystems I was responsible for. I could have spent over an hour on the phone describing how to deal with the problem in detail. Instead, I dialed into the system with my lap computer, and analyzed and fixed the problem in about ten minutes. Also on Wednesday, I dialed back into the local BBS and read the response to my restaurant inquiry. One

of the recommendations looked particularly enticing, and that evening my friends and I had a great Szechwan dinner at a place that wasn't listed in any of the where-to-eat booklets.

And on Thursday night, after an exhausting day of meetings, I wrote this column in my hotel room when I could have been wasting my time touring the city in a cable car.

But seriously, do I regret telecomputing on the run? Absolutely not. I doubt if I'll travel on business without telecomputing power again.

Watch for more under-$500 consumer-oriented lap portables with built-in modems in 1985. It's been found that integrated telecommunications is crucial to the success of lap computers. Consider two nearly identical lap machines, the Tandy TRS-80 Model 100 and the NEC 8201A. Both are manufactured by the Japanese firm Kyocera. The NEC has a clearly superior keyboard and more memory capacity than the Model 100. So why does the Model 100 outsell it by more than 20 to 1? The Tandy has a built-in modem, and as the sales figures show, that makes all the difference.

Even Commodore is said to be considering adding a modem to its portable SX-64 in an effort to spur sales. Indeed, it may soon be difficult to buy a microcomputer without a modem. The current availability of a $10, 300 bps modem-on-a-chip will have a profound effect on the telecomputing user base in the next few years. Because built-in modems add lots of functionality for little additional cost, you can expect the majority of new machines introduced in 1986 and beyond to sport integrated telecommunications.

Info-Wars

The commercial information service wars are heating up again. Recently, CompuServe has been gaining ground in the corporate computing community with its business-tailored Executive Information Service. This has the No. 1 business info provider—Dow Jones News/Retrieval—scrambling in response. DJNR has cut its rates by 25 percent across the board for general services and regular stock quotes, and has announced a major new service—stock quotes based upon "last trade."

What are last trade quotes? Until the announcement of this service, all of the stock quotes offered by the major consumer information utilities have been delayed 15 to 20 minutes. Anyone familiar with the stock market knows that 15 minutes can be a lifetime in the price of an individual issue. Last trade quotes report the most recent price paid for a stock, based on the last transaction logged by the exchange on which the stock is listed.

Transactions are reported much more quickly under the new system. The time varies from exchange to exchange, but 20 seconds or less is not uncommon. Moderately serious investors who don't have a broker willing to spend an hour at a time on the phone with them will find the new service a real blessing.

The last trade quotes will cost DJNR users a $12 monthly service charge in addition to the normal connect-time charges for quotes. The monthly surcharge covers the fees paid by Dow Jones to the exchanges for the more timely quote information.

DJNR didn't have much time to gloat before The Source—a rival information service owned by Reader's Digest—struck back in spades, announcing its own last trade quotes. Although The Source's $20 monthly surcharge is a bit higher than DJNR's, The Source introduced a powerful adjunct service. By special arrangement with Spears Incorporated, a discount brokerage house, stock watchers on The Source can set up an account with Spears and issue trading orders *on-line.* According to Spears, most orders will be executed within two minutes of issuance. An extensive portfolio tracking system is also available on-line and may be used to value actual holdings or to track "paper portfolios" (for those who wish to dabble for fun rather than real money).

New On-Line Services

The information service war is spreading beyond the business sector as well. Two new on-line services—People/Link and Play/Net—are starting up with introductory connect-time charges significantly below those charged by the established leaders.

People/Link will offer services similar to CompuServe's popular Nationwide CB and Special Interest Forums as well as electronic mail at only $2.95 an hour. Play/Net sounds even more aggressive, offering on-line games with medium-resolution color graphics to users who purchase its proprietary terminal program. Although the Commodore 64 is the only machine Play/Net supports at this time, the service claims it will support IBM and Apple computers by this spring. Play/Net's introductory connect time charges? An unbelievable $2.00 an hour! Both Play/Net's and People/Link's hourly charges will certainly rise after the two firms have lured enough users to make continued operation of the services viable, but such predatory pricing should help keep the rates charged by the big boys down to earth.

Arlan R. Levitan
Source: TCT987

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COMPUTE!'s Guide To Typing In Programs

Before typing in any program, you should familiarize yourself with your computer. Learn how to use the keyboard to type in and correct BASIC programs. Read your manuals to understand how to save and load BASIC programs to and from your disk drive or cassette unit. Computers are precise—take special care to type the program *exactly* as listed, including any necessary punctuation and symbols. To help you with this task, we have implemented a special listing convention as well as a program to help check your typing—the "Automatic Proofreader." Please read the following notes before typing in any programs from COMPUTE!. They can save you a lot of time and trouble.

Since programs can contain some hard-to-read (and hard-to-type) special characters, we have developed a listing system that spells out in abbreviated form the function of these control characters. You will find these special characters within curly braces. For example, {CLEAR} or {CLR} instructs you to insert the symbol which clears the screen on the Atari or Commodore machines. A symbol by itself within curly braces is usually a control key or graphics key. If you see {A}, hold down the CONTROL key and press A. Commodore machines have a special control key labeled with the Commodore logo. Graphics characters entered with the Commodore logo key are enclosed in a new kind of special bracket. A graphics character can be listed as [<A>]. In this case, hold down the Commodore logo key as you type A. Our Commodore listings are in uppercase, so shifted symbols are underlined. A graphics heart symbol (SHIFT-S) would be listed as S. One exception is {SHIFT-SPACE}. Hold down SHIFT and press the space bar.

If a number precedes a symbol, such as {5 RIGHT}, {6 S}, or [<8 Q>], you would enter five cursor rights, six shifted S's, or eight Commodore-Q's. On the Atari, inverse characters (printed in white on black) should be entered with the Atari logo key. Since spacing is sometimes important, any more than two spaces will be listed, for example, as: {6 SPACES}. A space is never left at the end of a line, but will be moved to the next printed line as {SPACE}. There are no special control characters found in our IBM PC/PCjr, TI-99/4A, and Apple program listings. For your convenience, we have prepared this quick-reference key for the Commodore and Atari special characters:

Atari 400/800/XL

When you see	Type	See
{CLEAR}	ESC SHIFT <	Clear Screen
{UP}	ESC CTRL -	Cursor Up
{DOWN}	ESC CTRL =	Cursor Down
{LEFT}	ESC CTRL +	Cursor Left
{RIGHT}	ESC CTRL *	Cursor Right
{BACK S}	ESC DELETE	Backspace
{DELETE}	ESC CTRL DELETE	Delete character
{INSERT}	ESC CTRL INSERT	Insert character
{DEL LINE}	ESC SHIFT DELETE	Delete line
{INS LINE}	ESC SHIFT INSERT	Insert line
{TAB}	ESC TAB	TAB key
{CLR TAB}	ESC CTRL TAB	Clear tab
{SET TAB}	ESC SHIFT TAB	Set tab stop
{BELL}	ESC CTRL 2	Ring buzzer
{ESC}	ESC ESC	ESCape key

Commodore PET/CBM/VIC/64

When You Read:	Press:	See:	When You Read:	Press:	See:
{CLR}	SHIFT CLR/HOME		{GRN}	CTRL 6	
{HOME}	CLR/HOME		{BLU}	CTRL 7	
{UP}	SHIFT CRSR ↕		{YEL}	CTRL 8	
{DOWN}	CRSR ↕		{F1}	f1	
{LEFT}	SHIFT CRSR ↔		{F2}	f2	
{RIGHT}	CRSR ↔		{F3}	f3	
{RVS}	CTRL 9		{F4}	f4	
{OFF}	CTRL 0		{F5}	f5	
{BLK}	CTRL 1		{F6}	f6	
{WHT}	CTRL 2		{F7}	f7	
{RED}	CTRL 3		{F8}	f8	
{CYN}	CTRL 4		←	←	
{PUR}	CTRL 5		↑	SHIFT ↕	

The Automatic Proofreader

Also, we have developed a simple, yet effective program that can help check your typing. Type in the appropriate Proofreader program for your machine, then save it for future use. On the VIC, 64, or Atari, run the Proofreader to activate it, then enter NEW to erase the BASIC loader (the Proofreader will still be active, hidden in memory, as a machine language program). Pressing RUN/STOP–RESTORE or SYSTEM RESET deactivates the Proofreader. You can use SYS 886 to reactivate the VIC/64 Proofreader, or PRINT USR(1536) to reenable the Atari Proofreader. The IBM Proofreader is a BASIC program that lets you enter, edit, list, save, and load programs that you type. It simulates the IBM's BASIC line editor.

Using The Automatic Proofreader

Once the Proofreader is active, try typing in a line. As soon as you press RETURN, either a number (on the Commodore) or a pair of letters

(Atari or IBM) appears. The number or pair of letters is called a *checksum*. Try making a change in the line, and notice how the checksum changes.

All you need to do is compare the value provided by the Proofreader with the checksum printed in the program listing in the magazine. In Commodore listings, the checksum is a number from 0 to 255. It is set off from the rest of the line with *rem*. This prevents a syntax error if the checksum is typed in, but the REM statements and checksums need *not* be typed in. It is just there for your information.

In Atari and IBM listings, the checksum is given to the left of each line number. Just type in the program, a line at a time (without the printed checksum) and compare the checksum generated by the Proofreader to the checksum in the listing. If they match, go on to the next line. If not, check your typing: You've made a mistake. On the Commodore and Atari Proofreader, spaces are not counted as part of the checksum, and no check is made to see that you've typed in the characters in the right order. If characters are transposed, the checksum will still match the listing. Because of the checksum method used, do not use abbreviations, such as ? for PRINT. However, the Proofreader does catch the majority of typing errors most people make. The IBM Proofreader is even pickier; it *will* detect errors in spacing and transposition. Also, be sure you leave Caps Lock on, except when you need to enter lowercase characters.

Special Proofreader Notes For Commodore Cassette Users

The Proofreader resides in the cassette buffer, which is used during tape LOADs and SAVEs. Be sure to press RUN/STOP–RESTORE before you save or load a program, to get the Proofreader out of the way. If you want to use the Proofreader with tape, run the Proofreader, then enter these two lines *exactly* as shown, pressing RETURN after each one:

```
A$="PROOFREADER.T":B$="{10 SPACES}"
    :FORX=1TO4:A$=A$+B$:NEXT
FORX=886TO1018:A$=A$+CHR$(PEEK(X))
    :NEXT:OPEN 1,1,1,A$:CLOSE1
```

Then press RECORD and PLAY on a blank tape, and a special version of the Proofreader will be saved to tape. Anytime you need to reload the Proofreader after it has been erased, just rewind the tape, type OPEN1:CLOSE1, then press PLAY. When READY comes back, enter SYS 886.

IBM Proofreader Commands

Since the IBM Proofreader replaces the computer's normal BASIC line editor, it has to include many of the direct-mode IBM BASIC commands. The syntax is identical to IBM BASIC. Commands simulated are LIST, LLIST, NEW, FILES, SAVE, and LOAD. When listing your program, press any key (except Ctrl-Break) to stop the listing. If you enter NEW, the Proofreader will prompt you to press Y to be especially sure you mean yes.

Two new commands are BASIC and CHECK. BASIC exits the Proofreader back to IBM BASIC, leaving the Proofreader in memory. CHECK works just like LIST, but shows the checksums along with the listing. After you have typed in a program, save it to disk. Then exit the Proofreader with the BASIC command, and load the program into the normal BASIC environment (this will replace the Proofreader in memory). You can now run the program, but you may want to resave it to disk. This will shorten it on disk and make it load faster, but it can no longer be edited with the Proofreader. If you want to convert a program to Proofreader format, save it to disk with SAVE "filename",A.

VIC/64 Proofreader

```
100 PRINT"{CLR}PLEASE WAIT...":FORI=886TO1018:READA:CK=CK+A:POKEI,A:NEXT
110 IF CK<>17539 THEN PRINT"{DOWN}YOU MADE {SPACE}AN ERROR":PRINT"IN DATA STATEMENTS.":END
120 SYS886:PRINT"{CLR}{2 DOWN}PROOFREADER ACTIVATED.":NEW
886 DATA 173,036,003,201,150,208
892 DATA 001,096,141,151,003,173
898 DATA 037,003,141,152,003,169
904 DATA 150,141,036,003,169,003
910 DATA 141,037,003,169,000,133
916 DATA 254,096,032,087,241,133
922 DATA 251,134,252,132,253,008
928 DATA 201,013,240,017,201,032
934 DATA 240,005,024,101,254,133
940 DATA 254,165,251,166,252,164
946 DATA 253,040,096,169,013,032
952 DATA 210,255,165,214,141,251
958 DATA 003,206,251,003,169,000
964 DATA 133,216,169,019,032,210
970 DATA 255,169,018,032,210,255
976 DATA 169,058,032,210,255,166
982 DATA 254,169,000,133,254,172
988 DATA 151,003,192,087,208,006
994 DATA 032,205,189,076,235,003
1000 DATA 032,205,221,169,032,032
1006 DATA 210,255,032,210,255,173
1012 DATA 251,003,133,214,076,173
1018 DATA 003
```

Atari Proofreader

```
100 GRAPHICS 0
110 FOR I=1536 TO 1700:READ A:POKE I,A:CK=CK+A:NEXT I
120 IF CK<>19072 THEN ? "Error in DATA Statements.  Check Typing.":END
130 A=USR(1536)
140 ? :? "Automatic Proofreader Now Activated."
```

```
150 END
1536 DATA 104,160,0,185,26,3
1542 DATA 201,69,240,7,200,200
1548 DATA 192,34,208,243,96,200
1554 DATA 169,74,153,26,3,200
1560 DATA 169,6,153,26,3,162
1566 DATA 0,189,0,228,157,74
1572 DATA 6,232,224,16,208,245
1578 DATA 169,93,141,78,6,169
1584 DATA 6,141,79,6,24,173
1590 DATA 4,228,105,1,141,95
1596 DATA 6,173,5,228,105,0
1602 DATA 141,96,6,169,0,133
1608 DATA 203,96,247,238,125,241
1614 DATA 93,6,244,241,115,241
1620 DATA 124,241,76,205,238,0
1626 DATA 0,0,0,0,32,62
1632 DATA 246,8,201,155,240,13
1638 DATA 201,32,240,7,72,24
1644 DATA 101,203,133,203,104,40
1650 DATA 96,72,152,72,138,72
1656 DATA 160,0,169,128,145,88
1662 DATA 200,192,40,208,249,165
1668 DATA 203,74,74,74,74,24
1674 DATA 105,161,160,3,145,88
1680 DATA 165,203,41,15,24,105
1686 DATA 161,200,145,88,169,0
1692 DATA 133,203,104,170,104,168
1698 DATA 104,40,96
```

IBM Proofreader

```
10 'Automatic Proofreader Version 2.00 (L
   ines 270,510,515,517,620,630 changed f
   rom V1.0)
100 DIM L$(500),LNUM(500):COLOR 0,7,7:KEY
    OFF:CLS:MAX=0:LNUM(0)=65536!
110 ON ERROR GOTO 120:KEY 15,CHR$(4)+CHR$
    (7Ø):ON KEY(15) GOSUB 640:KEY (15) ON
    :GOTO 130
120 RESUME 130
130 DEF SEG=&H40:W=PEEK(&H4A)
140 ON ERROR GOTO 650:PRINT:PRINT"Proofre
    ader Ready."
150 LINE INPUT L$:Y=CSRLIN-INT(LEN(L$)/W)
    -1:LOCATE Y,1
160 DEF SEG=0:POKE 1050,30:POKE 1052,34:P
    OKE 1054,0:POKE 1055,79:POKE 1056,13:
    POKE 1057,28:LINE INPUT L$:DEF SEG:IF
     L$="" THEN 150
170 IF LEFT$(L$,1)=" " THEN L$=MID$(L$,2)
    :GOTO 170
180 IF VAL(LEFT$(L$,2))=0 AND MID$(L$,3,1
    )=" " THEN L$=MID$(L$,4)
190 LNUM=VAL(L$):TEXT$=MID$(L$,LEN(STR$(L
    NUM))+1)
200 IF ASC(L$)>57 THEN 260 'no line numbe
    r, therefore command
210 IF TEXT$="" THEN GOSUB 540:IF LNUM=LN
    UM(P) THEN GOSUB 560:GOTO 150 ELSE 15
    0
220 CKSUM=0:FOR I=1 TO LEN(L$):CKSUM=(CKS
    UM+ASC(MID$(L$,I))*I) AND 255:NEXT:LO
    CATE Y,1:PRINT CHR$(65+CKSUM/16)+CHR$
    (65+(CKSUM AND 15))+" "+L$
230 GOSUB 540:IF LNUM(P)=LNUM THEN L$(P)=
    TEXT$:GOTO 150 'replace line
240 GOSUB 580:GOTO 150 'insert the line
260 TEXT$="":FOR I=1 TO LEN(L$):A=ASC(MID
    $(L$,I)):TEXT$=TEXT$+CHR$(A+32*(A>96
    AND A<123)):NEXT
270 DELIMITER=INSTR(TEXT$," "):COMMAND$=T
    EXT$:ARG$="":IF DELIMITER THEN COMMAN
    D$=LEFT$(TEXT$,DELIMITER-1):ARG$=MID$
    (TEXT$,DELIMITER+1) ELSE DELIMITER=IN
    STR(TEXT$,CHR$(34)):IF DELIMITER THEN
     COMMAND$=LEFT$(TEXT$,DELIMITER-1):AR
    G$=MID$(TEXT$,DELIMITER)
280 IF COMMAND$<>"LIST" THEN 410
290 OPEN "scrn:" FOR OUTPUT AS #1
300 IF ARG$="" THEN FIRST=0:P=MAX-1:GOTO
    340
310 DELIMITER=INSTR(ARG$,"-"):IF DELIMITE
    R=0 THEN LNUM=VAL(ARG$):GOSUB 540:FIR
    ST=P:GOTO 340
320 FIRST=VAL(LEFT$(ARG$,DELIMITER)):LAST
    =VAL(MID$(ARG$,DELIMITER+1))
330 LNUM=FIRST:GOSUB 540:FIRST=P:LNUM=LAS
    T:GOSUB 540:IF P=0 THEN P=MAX-1
340 FOR X=FIRST TO P:N$=MID$(STR$(LNUM(X)
    ),2)+" "
350 IF CKFLAG=0 THEN A$="":GOTO 370
360 CKSUM=0:A$=N$+L$(X):FOR I=1 TO LEN(A$
    ):CKSUM=(CKSUM+ASC(MID$(A$,I))*I) AND
     255:NEXT:A$=CHR$(65+CKSUM/16)+CHR$(6
    5+(CKSUM AND 15))+" "
370 PRINT #1,A$+N$+L$(X)
380 IF INKEY$<>"" THEN X=P
390 NEXT :CLOSE #1:CKFLAG=0
400 GOTO 130
410 IF COMMAND$="LLIST" THEN OPEN "lpt1:"
     FOR OUTPUT AS #1:GOTO 300
420 IF COMMAND$="CHECK" THEN CKFLAG=1:GOT
    O 290
430 IF COMMAND$<>"SAVE" THEN 450
440 GOSUB 600:OPEN ARG$ FOR OUTPUT AS #1:
    ARG$="":GOTO 300
450 IF COMMAND$<>"LOAD" THEN 490
460 GOSUB 600:OPEN ARG$ FOR INPUT AS #1:M
    AX=0:P=0
470 WHILE NOT EOF(1):LINE INPUT #1,L$:LNU
    M(P)=VAL(L$):L$(P)=MID$(L$,LEN(STR$(V
    AL(L$)))+1):P=P+1:WEND
480 MAX=P:CLOSE #1:GOTO 130
490 IF COMMAND$="NEW" THEN INPUT "Erase p
    rogram - Are you sure";L$:IF LEFT$(L$
    ,1)="y" OR LEFT$(L$,1)="Y" THEN MAX=0
    :GOTO 130:ELSE 130
500 IF COMMAND$="BASIC" THEN COLOR 7,0,0:
    ON ERROR GOTO 0:CLS:END
510 IF COMMAND$<>"FILES" THEN 520
515 IF ARG$="" THEN ARG$="A:" ELSE SEL=1:
    GOSUB 600
517 FILES ARG$:GOTO 130
520 PRINT"Syntax error":GOTO 130
540 P=0:WHILE LNUM>LNUM(P) AND P<MAX:P=P+
    1:WEND:RETURN
560 MAX=MAX-1:FOR X=P TO MAX:LNUM(X)=LNUM
    (X+1):L$(X)=L$(X+1):NEXT:RETURN
580 MAX=MAX+1:FOR X=MAX TO P+1 STEP -1:LN
    UM(X)=LNUM(X-1):L$(X)=L$(X-1):NEXT:L$
    (P)=TEXT$:LNUM(P)=LNUM:RETURN
600 IF LEFT$(ARG$,1)<>CHR$(34) THEN 520 E
    LSE ARG$=MID$(ARG$,2)
610 IF RIGHT$(ARG$,1)=CHR$(34) THEN ARG$=
    LEFT$(ARG$,LEN(ARG$)-1)
620 IF SEL=0 AND INSTR(ARG$,".")=0 THEN A
    RG$=ARG$+".BAS"
630 SEL=0:RETURN
640 CLOSE #1:CKFLAG=0:PRINT"Stopped.":RET
    URN 150
650 PRINT "Error #";ERR:RESUME 150
```

MLX Machine Language Entry Program For Commodore 64 And VIC-20

Charles Brannon, Program Editor

MLX is a labor-saving utility that allows almost fail-safe entry of machine language programs published in COMPUTE!. You need to know nothing about machine language to use MLX—it was designed for everyone. There are separate versions for the Commodore 64 and expanded VIC-20 (at least 8K).

MLX is a new way to enter long machine language (ML) programs with a minimum of fuss. MLX lets you enter the numbers from a special list that looks similar to BASIC DATA statements. It checks your typing on a line-by-line basis. It won't let you enter illegal characters when you should be typing numbers. It won't let you enter numbers greater than 255 (forbidden in ML). It won't let you enter the wrong numbers on the wrong line. In addition, MLX creates a ready-to-use tape or disk file.

Using MLX

Type in and save the appropriate version of MLX (you'll want to use it in the future). When you're ready to type in an ML program, run MLX. MLX asks you for two numbers: the starting address and the ending address. These numbers are given in the article accompanying the ML program.

When you run MLX, you'll see a prompt corresponding to the starting address. The prompt is the current line you are entering from the listing. It increases by six each time you enter a line. That's because each line has seven numbers—six actual data numbers plus a *checksum number*. The checksum verifies that you typed the previous six numbers correctly. If you enter any of the six numbers wrong, or enter the checksum wrong, the computer rings a buzzer and prompts you to reenter the line. If you enter it correctly, a bell tone sounds and you continue to the next line.

MLX accepts only numbers as input. If you make a typing error, press the INST/DEL key; the entire number is deleted. You can press it as many times as necessary back to the start of the line. If you enter three-digit numbers as listed, the computer automatically prints the comma and goes on to accept the next number. If you enter less than three digits, you can press either the space bar or RETURN key to advance to the next number. The checksum automatically appears in inverse video for emphasis.

To simplify your typing, MLX redefines part of the keyboard as a numeric keypad (lines 581–584):

```
    U  I  O              7  8  9
H   J  K  L  become  0   4  5  6
    M  ,  .              1  2  3
```

MLX Commands

When you finish typing an ML listing (assuming you type it all in one session), you can then save the completed program on tape or disk. Follow the screen instructions. If you get any errors while saving, you probably have a bad disk, or the disk is full, or you've made a typo when entering the MLX program itself.

You don't have to enter the whole ML program in one sitting. MLX lets you enter as much as you want, save it, and then reload the file from tape or disk later. MLX recognizes these commands:

SHIFT-S: Save
SHIFT-L: Load
SHIFT-N: New Address
SHIFT-D: Display

When you enter a command, MLX jumps out of the line you've been typing, so we recommend you do it at a new prompt. Use the Save command to save what you've been working on. It will save on tape or disk, as if you've finished, but the tape or disk won't work, of course, until you finish the typing. Remember what address you stop at. The next time you run MLX, answer all the prompts as you did before, then insert the disk or tape. When you get to the entry prompt, press SHIFT-L to reload the partly completed file into memory. Then use the New Address command to resume typing.

To use the New Address command, press SHIFT-N and enter the address where you previously stopped. The prompt will change, and you can then continue typing. Always enter a New Address that matches up with one of the line numbers in the special listing, or else the checksum won't work. The Display command lets you display a section of your typing. After you press SHIFT-D, enter two addresses within the line number range of the listing. You can abort the listing by pressing any key.

64 MLX: Machine Language Entry

```
10 REM LINES CHANGED FROM MLX VERSION 2.0
   Ø ARE 750,765,770 AND 860        :rem 50
20 REM LINE CHANGED FROM MLX VERSION 2.01
    IS 300                          :rem 147
```

```
100 PRINT"{CLR}{6}";CHR$(142);CHR$(8);:PO
    KE53281,1:POKE53280,1          :rem 67
101 POKE 788,52:REM DISABLE RUN/STOP
                                   :rem 119
110 PRINT"{RVS}{39 SPACES}";       :rem 176
120 PRINT"{RVS}{14 SPACES}{RIGHT}{OFF}{*}
    £{RVS}{RIGHT} {RIGHT}{2 SPACES}{*}
    {OFF}{*}£{RVS}£{RVS}{14 SPACES}";
                                   :rem 250
130 PRINT"{RVS}{14 SPACES}{RIGHT} {G}
    {RIGHT} {2 RIGHT} {OFF}£{RVS}£{*}
    {OFF}{*}{RVS}{14 SPACES}";     :rem 35
140 PRINT"{RVS}{41 SPACES}"        :rem 120
200 PRINT"{2 DOWN}{PUR}{BLK} MACHINE LANG
    UAGE EDITOR VERSION 2.02{5 DOWN}"
                                   :rem 238
210 PRINT"{5}{2 UP}STARTING ADDRESS?
    {8 SPACES}{9 LEFT}";           :rem 143
215 INPUTS:F=1-F:C$=CHR$(31+119*F)
                                   :rem 166
220 IFS<256ORS>40960ANDS<49152)ORS>53247
    THENGOSUB3000:GOTO210          :rem 235
225 PRINT:PRINT:PRINT              :rem 180
230 PRINT"{5}{2 UP}ENDING ADDRESS?
    {8 SPACES}{9 LEFT}";:INPUTE:F=1-F:C$=
    CHR$(31+119*F)                 :rem 20
240 IFE<256ORE>40960ANDE<49152)ORE>53247
    THENGOSUB3000:GOTO230          :rem 183
250 IFE<STHENPRINTC$;"{RVS}ENDING < START
    {2 SPACES}":GOSUB1000:GOTO 230
                                   :rem 176
260 PRINT:PRINT:PRINT              :rem 179
300 PRINT"{CLR}";CHR$(14):AD=S     :rem 56
310 A=1:PRINTRIGHT$("0000"+MID$(STR$(AD),
    2),5);":";                     :rem 33
315 FORJ=ATO6                      :rem 33
320 GOSUB570:IFN=-1THENJ=J+N:GOTO320
                                   :rem 228
390 IFN=-211THEN 710               :rem 62
400 IFN=-204THEN 790               :rem 64
410 IFN=-206THENPRINT:INPUT"{DOWN}ENTER N
    EW ADDRESS";ZZ                 :rem 44
415 IFN=-206THENIFZZ<SORZZ>ETHENPRINT"
    {RVS}OUT OF RANGE":GOSUB1000:GOTO410
                                   :rem 225
417 IFN=-206THENAD=ZZ:PRINT:GOTO310
                                   :rem 238
420 IF N<>-196 THEN 480            :rem 133
430 PRINT:INPUT"DISPLAY:FROM";F:PRINT,"TO
    ";:INPUTT                      :rem 234
440 IFF<SORF>EORT<SORT>ETHENPRINT"AT LEAS
    T";S;"{LEFT}, NOT MORE THAN";E:GOTO43
    0                              :rem 159
450 FORI=FTOTSTEP6:PRINT:PRINTRIGHT$("000
    0"+MID$(STR$(I),2),5);":";     :rem 30
451 FORK=0TO5:N=PEEK(I+K):PRINTRIGHT$("00
    "+MID$(STR$(N),2),3);",";      :rem 66
460 GETA$:IFA$>""THENPRINT:PRINT:GOTO310
                                   :rem 25
470 NEXTK:PRINTCHR$(20);:NEXTI:PRINT:PRIN
    T:GOTO310                      :rem 50
480 IFN<0 THEN PRINT:GOTO310       :rem 168
490 A(J)=N:NEXTJ                   :rem 199
500 CKSUM=AD-INT(AD/256)*256:FORI=1TO6:CK
    SUM=(CKSUM+A(I))AND255:NEXT    :rem 200
510 PRINTCHR$(18);:GOSUB570:PRINTCHR$(146
    );                             :rem 94
511 IFN=-1THENA=6:GOTO315          :rem 254
515 PRINTCHR$(20):IFN=CKSUMTHEN530
                                   :rem 122
520 PRINT:PRINT"LINE ENTERED WRONG : RE-E
    NTER":PRINT:GOSUB1000:GOTO310:rem 176
530 GOSUB2000                      :rem 218
540 FORI=1TO6:POKEAD+I-1,A(I):NEXT:POKE54
    272,0:POKE54273,0              :rem 227
550 AD=AD+6:IF AD<E THEN 310       :rem 212
560 GOTO 710                       :rem 108
570 N=0:Z=0                        :rem 88
580 PRINT"{£}";                    :rem 81
581 GETA$:IFA$=""THEN581           :rem 95
582 AV=-(A$="M")-2*(A$=",")-3*(A$=".")-4*
    (A$="J")-5*(A$="K")-6*(A$="L"):rem 41
583 AV=AV-7*(A$="U")-8*(A$="I")-9*(A$="O"
    ):IFA$="H"THENA$="0"           :rem 134
584 IFAV>0THENA$=CHR$(48+AV)       :rem 134
585 PRINTCHR$(20);:A=ASC(A$):IFA=13ORA=44
    ORA=32THEN670                  :rem 229
590 IFA>128THENN=-A:RETURN         :rem 137
600 IFA<>20 THEN 630               :rem 10
610 GOSUB690:IFI=1ANDT=44THENN=-1:PRINT"
    {OFF}{LEFT} {LEFT}";:GOTO690   :rem 62
620 GOTO570                        :rem 109
630 IFA<48ORA>57THEN580            :rem 105
640 PRINTA$;:N=N*10+A-48           :rem 106
650 IFN>255 THEN A=20:GOSUB1000:GOTO600
                                   :rem 229
660 Z=Z+1:IFZ<3THEN580             :rem 71
670 IFZ=0THENGOSUB1000:GOTO570     :rem 114
680 PRINT",";:RETURN               :rem 240
690 S%=PEEK(209)+256*PEEK(210)+PEEK(211)
                                   :rem 149
691 FORI=1TO3:T=PEEK(S%-I)         :rem 67
695 IFT<>44ANDT<>58THENPOKES%-I,32:NEXT
                                   :rem 205
700 PRINTLEFT$("{3 LEFT}",I-1);:RETURN
                                   :rem 7
710 PRINT"{CLR}{RVS}*** SAVE ***{3 DOWN}"
                                   :rem 236
715 PRINT"{2 DOWN}(PRESS {RVS}RETURN{OFF}
     ALONE TO CANCEL SAVE){DOWN}":rem 106
720 F$="":INPUT"{DOWN} FILENAME";F$:IFF$=
    ""THENPRINT:PRINT:GOTO310      :rem 71
730 PRINT:PRINT"{2 DOWN}{RVS}T{OFF}APE OR
     {RVS}D{OFF}ISK: (T/D)"        :rem 228
740 GETA$:IFA$<>"T"ANDA$<>"D"THEN740
                                   :rem 36
750 DV=1-7*(A$="D"):IFDV=8THENF$="0:"+F$:
    OPEN15,8,15,"S"+F$:CLOSE15     :rem 212
760 T$=F$:ZK=PEEK(53)+256*PEEK(54)-LEN(T$
    ):POKE782,ZK/256               :rem 3
762 POKE781,ZK-PEEK(782)*256:POKE780,LEN(
    T$):SYS65469                   :rem 109
763 POKE780,1:POKE781,DV:POKE782,1:SYS654
    66                             :rem 69
765 K=S:POKE254,K/256:POKE253,K-PEEK(254)
    *256:POKE780,253               :rem 17
766 K=E+1:POKE782,K/256:POKE781,K-PEEK(78
    2)*256:SYS65496                :rem 235
770 IF(PEEK(783)AND1)OR(191ANDST)THEN780
                                   :rem 111
775 PRINT"{DOWN}DONE.{DOWN}":GOTO310
                                   :rem 113
780 PRINT"{DOWN}ERROR ON SAVE.{2 SPACES}T
    RY AGAIN.":IFDV=1THEN720       :rem 171
781 OPEN15,8,15:INPUT#15,E1$,E2$:PRINTE1$
    ;E2$:CLOSE15:GOTO720           :rem 103
790 PRINT"{CLR}{RVS}*** LOAD ***{2 DOWN}"
                                   :rem 212
795 PRINT"{2 DOWN}(PRESS {RVS}RETURN{OFF}
     ALONE TO CANCEL LOAD)"        :rem 82
800 F$="":INPUT"{2 DOWN} FILENAME";F$:IFF
    $=""THENPRINT:GOTO310          :rem 144
810 PRINT:PRINT"{2 DOWN}{RVS}T{OFF}APE OR
     {RVS}D{OFF}ISK: (T/D)"        :rem 227
```

```
820 GETA$:IFA$<>"T"ANDA$<>"D"THEN820
                                    :rem 34
830 DV=1-7*(A$="D"):IFDV=8THENF$="0:"+F$
                                    :rem 157
840 T$=F$:ZK=PEEK(53)+256*PEEK(54)-LEN(T$
    ):POKE782,ZK/256                :rem 2
841 POKE781,ZK-PEEK(782)*256:POKE780,LEN(
    T$):SYS65469                    :rem 107
845 POKE780,1:POKE781,DV:POKE782,1:SYS654
    66                              :rem 70
850 POKE780,0:SYS65493              :rem 11
860 IF(PEEK(783)AND1)OR(191ANDST)THEN870
                                    :rem 111
865 PRINT"{DOWN}DONE.":GOTO310      :rem 96
870 PRINT"{DOWN}ERROR ON LOAD.{2 SPACES}T
    RY AGAIN.{DOWN}":IFDV=1THEN800
                                    :rem 172
880 OPEN15,8,15:INPUT#15,E1$,E2$:PRINTE1$
    ;E2$:CLOSE15:GOTO800            :rem 102
1000 REM BUZZER                     :rem 135
1001 POKE54296,15:POKE54277,45:POKE54278,
     165                            :rem 207
1002 POKE54276,33:POKE 54273,6:POKE54272,
     5                              :rem 42
1003 FORT=1TO200:NEXT:POKE54276,32:POKE54
     273,0:POKE54272,0:RETURN       :rem 202
2000 REM BELL SOUND                 :rem 78
2001 POKE54296,15:POKE54277,0:POKE54278,2
     47                             :rem 152
2002 POKE 54276,17:POKE54273,40:POKE54272
     ,0                             :rem 86
2003 FORT=1TO100:NEXT:POKE54276,16:RETURN
                                    :rem 57
3000 PRINTC$;"{RVS}NOT ZERO PAGE OR ROM":
     GOTO1000                       :rem 89
```

VIC MLX: Machine Language Entry

```
100 PRINT"{CLR}{PUR}";CHR$(142);CHR$(8);
                                    :rem 181
101 POKE 788,194:REM DISABLE RUN/STOP
                                    :rem 174
110 PRINT"{RVS}{14 SPACES}"         :rem 117
120 PRINT"{RVS} {RIGHT}{OFF}[*]£{RVS}
    {RIGHT} {RIGHT}{2 SPACES}[*]{OFF}[*]
    £{RVS}£{RVS} "                  :rem 191
130 PRINT"{RVS} {RIGHT} [G]{RIGHT}
    {2 RIGHT} {OFF}£{RVS}£[*]{OFF}[*]
    {RVS} "                         :rem 232
140 PRINT"{RVS}{14 SPACES}"         :rem 120
200 PRINT"{2 DOWN}{PUR}{BLK}A FAILSAFE MA
    CHINE":PRINT"LANGUAGE EDITOR{5 DOWN}"
                                    :rem 141
210 PRINT"{BLK}{3 UP}STARTING ADDRESS":IN
    PUTS:F=1-F:C$=CHR$(31+119*F)    :rem 97
220 IFS<256ORS>32767THENGOSUB3000:GOTO210
                                    :rem 2
225 PRINT:PRINT:PRINT:PRINT         :rem 123
230 PRINT"{BLK}{3 UP}ENDING ADDRESS":INPU
    TE:F=1-F:C$=CHR$(31+119*F)      :rem 158
240 IFE<256ORE>32767THENGOSUB3000:GOTO230
                                    :rem 234
250 IFE<STHENPRINTC$;"{RVS}ENDING < START
    {2 SPACES}":GOSUB1000:GOTO 230
                                    :rem 176
260 PRINT:PRINT:PRINT               :rem 179
300 PRINT"{CLR}";CHR$(14):AD=S      :rem 56
310 PRINTRIGHT$("0000"+MID$(STR$(AD),2),5
    );":";:FORJ=1TO6                :rem 234
320 GOSUB570:IFN=-1THENJ=J+N:GOTO320
                                    :rem 228
390 IFN=-211THEN 710                :rem 62
400 IFN=-204THEN 790                :rem 64
410 IFN=-206THENPRINT:INPUT"{DOWN}ENTER N
    EW ADDRESS";ZZ                  :rem 44
415 IFN=-206THENIFZZ<SORZZ>ETHENPRINT"
    {RVS}OUT OF RANGE":GOSUB1000:GOTO410
                                    :rem 225
417 IFN=-206THENAD=ZZ:PRINT:GOTO310
                                    :rem 238
420 IF N<>-196 THEN 480             :rem 133
430 PRINT:INPUT"DISPLAY:FROM";F:PRINT,"TO
    ";:INPUTT                       :rem 234
440 IFF<SORF>EORT<SORT>ETHENPRINT"AT LEAS
    T";S;"{LEFT}, NOT MORE THAN";E:GOTO43
    0                               :rem 159
450 FORI=FTOTSTEP6:PRINT:PRINTRIGHT$("000
    0"+MID$(STR$(I),2),5);":";      :rem 30
455 FORK=0TO5:N=PEEK(I+K):IFK=3THENPRINTS
    PC(10);                         :rem 34
457 PRINTRIGHT$("00"+MID$(STR$(N),2),3);"
    ,";                             :rem 157
460 GETA$:IFA$>""THENPRINT:PRINT:GOTO310
                                    :rem 25
470 NEXTK:PRINTCHR$(20);:NEXTI:PRINT:PRIN
    T:GOTO310                       :rem 50
480 IFN<0 THEN PRINT:GOTO310        :rem 168
490 A(J)=N:NEXTJ                    :rem 199
500 CKSUM=AD-INT(AD/256)*256:FORI=1TO6:CK
    SUM=(CKSUM+A(I))AND255:NEXT     :rem 200
510 PRINTCHR$(18);:GOSUB570:PRINTCHR$(20)
                                    :rem 234
515 IFN=CKSUMTHEN530                :rem 255
520 PRINT:PRINT"LINE ENTERED WRONG":PRINT
    "RE-ENTER":PRINT:GOSUB1000:GOTO310
                                    :rem 129
530 GOSUB2000                       :rem 218
540 FORI=1TO6:POKEAD+I-1,A(I):NEXT:rem 80
550 AD=AD+6:IF AD<E THEN 310        :rem 212
560 GOTO 710                        :rem 108
570 N=0:Z=0                         :rem 88
580 PRINT"[+]";                     :rem 79
581 GETA$:IFA$=""THEN581            :rem 95
585 PRINTCHR$(20);:A=ASC(A$):IFA=13ORA=44
    ORA=32THEN670                   :rem 229
590 IFA>128THENN=-A:RETURN          :rem 137
600 IFA<>20 THEN 630                :rem 10
610 GOSUB690:IFI=1ANDT=44THENN=-1:PRINT"
    {LEFT} {LEFT}";:GOTO690         :rem 172
620 GOTO570                         :rem 109
630 IFA<48ORA>57THEN580             :rem 105
640 PRINTA$;:N=N*10+A-48            :rem 106
650 IFN>255 THEN A=20:GOSUB1000:GOTO600
                                    :rem 229
660 Z=Z+1:IFZ<3THEN580              :rem 71
670 IFZ=0THENGOSUB1000:GOTO570      :rem 114
680 PRINT",";:RETURN                :rem 240
690 S%=PEEK(209)+256*PEEK(210)+PEEK(211)
                                    :rem 149
692 FORI=1TO3:T=PEEK(S%-I)          :rem 68
695 IFT<>44ANDT<>58THENPOKES%-I,32:NEXT
                                    :rem 205
700 PRINTLEFT$("{3 LEFT}",I-1);:RETURN
                                    :rem 7
710 PRINT"{CLR}{RVS}*** SAVE ***{3 DOWN}"
                                    :rem 236
720 INPUT"{DOWN} FILENAME";F$       :rem 228
730 PRINT:PRINT"{2 DOWN}{RVS}T{OFF}APE OR
    {RVS}D{OFF}ISK: (T/D)"          :rem 228
740 GETA$:IFA$<>"T"ANDA$<>"D"THEN740
                                    :rem 36
750 DV=1-7*(A$="D"):IFDV=8THENF$="0:"+F$
                                    :rem 158
760 T$=F$:ZK=PEEK(53)+256*PEEK(54)-LEN(T$
    ):POKE782,ZK/256                :rem 3
```

```
762 POKE781,ZK-PEEK(782)*256:POKE780,LEN(
    T$):SYS65469                    :rem 109
763 POKE780,1:POKE781,DV:POKE782,1:SYS654
    66                              :rem 69
765 POKE254,S/256:POKE253,S-PEEK(254)*256
    :POKE780,253                    :rem 12
766 POKE782,E/256:POKE781,E-PEEK(782)*256
    :SYS65496                       :rem 124
770 IF(PEEK(783)AND1)OR(ST AND191)THEN780
                                    :rem 111
775 PRINT"{DOWN}DONE.":END          :rem 106
780 PRINT"{DOWN}ERROR ON SAVE.{2 SPACES}T
    RY AGAIN.":IFDV=1THEN720        :rem 171
781 OPEN15,8,15:INPUT#15,E1$,E2$:PRINTE1$
    ;E2$:CLOSE15:GOTO720            :rem 103
782 GOTO720                         :rem 115
790 PRINT"{CLR}{RVS}*** LOAD ***{2 DOWN}"
                                    :rem 212
800 INPUT"{2 DOWN} FILENAME";F$     :rem 244
810 PRINT:PRINT"{2 DOWN}{RVS}T{OFF}APE OR
     {RVS}D{OFF}ISK: (T/D)"         :rem 227
820 GETA$:IFA$<>"T"ANDA$<>"D"THEN820
                                    :rem 34
830 DV=1-7*(A$="D"):IFDV=8THENF$="0:"+F$
                                    :rem 157
840 T$=F$:ZK=PEEK(53)+256*PEEK(54)-LEN(T$
    ):POKE782,ZK/256                :rem 2
841 POKE781,ZK-PEEK(782)*256:POKE780,LEN(
    T$):SYS65469                    :rem 107
845 POKE780,1:POKE781,DV:POKE782,1:SYS654
    66                              :rem 70
850 POKE780,0:SYS65493              :rem 11
860 IF(PEEK(783)AND1)OR(ST AND191)THEN870
                                    :rem 111
865 PRINT"{DOWN}DONE.":GOTO310      :rem 96
870 PRINT"{DOWN}ERROR ON LOAD.{2 SPACES}T
    RY AGAIN.{DOWN}":IFDV=1THEN800
                                    :rem 172
880 OPEN15,8,15:INPUT#15,E1$,E2$:PRINTE1$
    ;E2$:CLOSE15:GOTO800            :rem 102
1000 REM BUZZER                     :rem 135
1001 POKE36878,15:POKE36874,190     :rem 206
1002 FORW=1TO300:NEXTW              :rem 117
1003 POKE36878,0:POKE36874,0:RETURN
                                    :rem 74
2000 REM BELL SOUND                 :rem 78
2001 FORW=15TO0STEP-1:POKE36878,W:POKE368
     76,240:NEXTW                   :rem 22
2002 POKE36876,0:RETURN             :rem 119
3000 PRINTC$;"{RVS}NOT ZERO PAGE OR ROM":
     GOTO1000                       :rem 89
```

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Copy Atari 400/800/XL Series Cartridges to Disk and run them from a Menu

ATARI CARTRIDGE-TO-DISK COPY SYSTEM $69.95

Supercart lets you copy *ANY* cartridge for the Atari 400/800/XL Series to diskette, and thereafter run it from your disk drive. Enjoy the convenience of selecting your favorite games from a "menu screen" rather than swapping cartridges in and out of your computer. Each cartridge copied by Supercart functions *exactly like the original.* Supercart includes:

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Available at your computer store or direct from FRONTRUNNER. DEALER INQUIRIES ENCOURAGED.
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Modifications Or Corrections To Previous Articles

Enhanced 64 DOS Support

Author Stephen Melsheimer reports that a number of readers have uncovered a problem with the "LOAD and RUN" (↑) command of this utility (p. 163, November 1984). Occasionally a program—especially one with DATA statements—will fail to load and run properly. To correct this, he suggests that the following two lines be modified as shown:

```
1510 DATA 144, 255, 32, 89, 166, 76
1630 DATA 76, 144, 205, -1, 9616
```

Additionally, the article (p. 166) mentions that the wedge can be activated from within a program with SYS 52222. The correct value is SYS 52224.

64 Paintbox

There are several errors in the article for this graphics utility from the December 1984 issue. It states (p. 118) that you should use the filename 64 PAINTBOX if you want to use the loader program (Program 2). Actually, Program 2 looks for the filename PAINTBOX. You can either rename the saved file to PAINTBOX or change the string in line 230 of Program 2 to 64 PAINTBOX. Also, a line is missing in the first paragraph of the right column of that page. The sentence in parentheses should read: "(If you're using tape, Program 2 should precede 64 Paintbox on the tape, and the 8 in line 230 should be changed to a 1.)"

Apple Chess

The Apple version of "Chess" from the December 1984 issue (p. 102) works fine on the Apple IIc, but the program doesn't respond to keyboard commands when used on the II+ or IIe. To correct this, change the following lines:

```
350 IF PEEK (-16384) < 128 THEN 350
550 I = PEEK (-16384): POKE -16368,0
```

Thanks to Gene and Brian Schmidt for discovering this oversight.

Atari Reflection

The Atari version (Program 1, p. 59) of this game from the November 1984 issue requires the two players to share one joystick. If you have two joysticks, reader William Q. Zapf suggests the following simple modifications to allow the program to read two joysticks:

```
NJ 1240 POKE 77,N0:Q=STICK(TURN-1):IF
        Q=10 OR Q=14 OR Q=N6 THEN IF
        YP>N1 THEN YP=YP-N1
MO 1340 IF STRIG(TURN-1) THEN 1240
```

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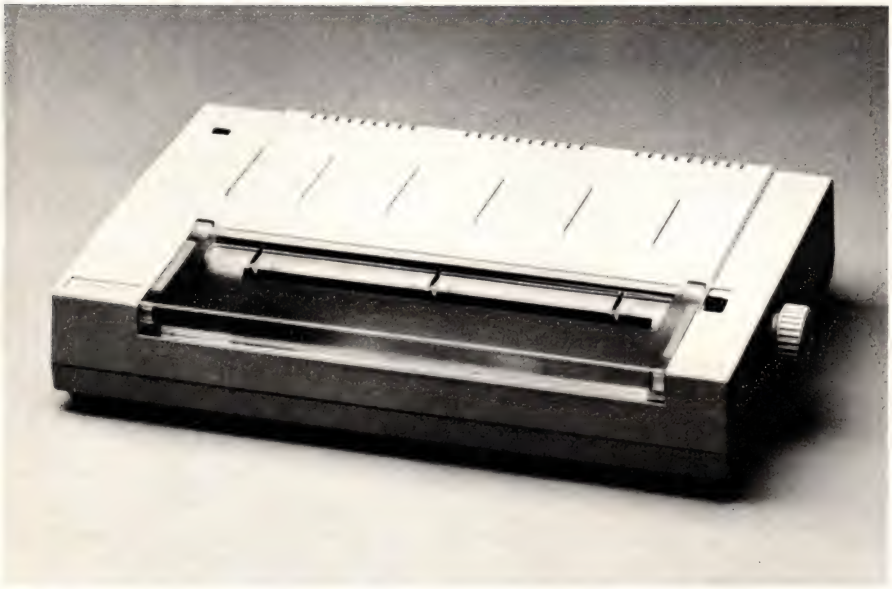
NEWS&PRODUCTS



The Riteman LQ is a letter-quality printer that retails for $299 and prints 20 characters per second.

New Printers

Riteman Computer Printers has introduced a line of printers which is compatible with most home computers. Among the new printers are:

The Riteman LQ ($299), a letter-quality printer which has a print speed of 20 characters per second (cps); the Riteman Plus ($399), a dot-matrix printer which can print at 120 cps; the Riteman Blue Plus ($499), a dot-matrix printer which prints at 140 cps and can print graphics. Included are eight international character sets and 32 block graphic characters. The Riteman II ($549 with 2K RAM and $599 with 8K RAM) is a dot-matrix printer with a print speed of 160 cps.

Riteman Computer Printers
Airport Business Park
431 Oak St.
Inglewood, CA 90302

Apple Home Applications Package

Work Force II, a collection of six programs for home and office, has been introduced by Core Concepts for Apple II and III computers.

Included in the package are a loan analyzer; a checkbook balancer; a calculator; the line writer, a line-at-a-time word processor for such small writing jobs as envelopes; the savings analyzer; and the wages analyzer.

All six programs support printing, so hard copies can be made of data. Suggested retail price is $34.95.

Core Concepts
P.O. Box 24157
Tempe, AZ 85282

New Games For Commodore, Atari

Microcomputer Games, a division of The Avalon Hill Game Company, has released a number of new games for various computers. Among the new titles are the following:

Market Forces, a business game which simulates the buying and selling of commodities ($16 cassette; $21 disk, for

A screen shot from Market Forces, *a new game from Microcomputer Games, Inc., for the Commodore 64 and Atari computers.*

Commodore 64 and Atari computers); *Gulf Strike*, a simulation of land, air, and naval combat in the Middle East ($30 disk, for Atari computers); and *Clear for Action*, a ship-to-ship combat game ($25 cassette, $30 disk, Atari computers).

Microcomputer Games, Inc.
The Avalon Hill Game Co.
4517 Harford Rd.
Baltimore, MD 21214

Apple II Word Processor

The *Milliken Word Processor*, a program designed to teach children the fundamentals of writing on a computer, has been released for Apple II series computers by Milliken Publishing Company.

It teaches how to use the computer for composing, structuring, editing, and filing written material, and has most basic word-processing functions, including graphics to ease understanding of functions.

Designed for children ages seven and older, the word processor retails for $69.95.

Milliken Publishing Co.
1100 Research Blvd.
P.O. Box 21579
St. Louis, MO 63132

New Text Adventures

Infocom has released two new text adventures for most home computers, *Suspect* and *The Hitchhiker's Guide to the Galaxy.*

In *Suspect*, the player takes the role of a newspaper reporter invited to a masquerade ball—who ends up being accused of murder. You must prove your innocence, and also find out who committed the crime and why.

The Hitchhiker's Guide to the Galaxy is an adaptation of the novel of the same name by Douglas Adams. The player is protagonist Arthur Dent, who goes off on a journey through the universe with his friend, Ford Prefect.

Suspect retails for $39.95 for the Atari and Commodore 64 versions, and $44.95 for versions on most other personal computers. *Hitchhiker's Guide to the Galaxy* has a suggested retail price of $34.95 for the Commodore and Atari versions, with other versions retailing for $39.95.

Infocom, Inc.
55 Wheeler St.
Cambridge, MA 02138

Bridge For IBM, Apple, Commodore

A bridge game for one or more players, *BridgePro*, has been released for the IBM PC and PCjr, Apple II series, and Commodore 64 computers by Computer Management Corporation.

BridgePro allows one person to bid with all hands randomly dealt. Other options are two-player versions, a best hand option, replay of hands, and separate instructions for beginning bridge players.

Suggested retail price is $35. *BridgePro* is available on disk.

Computer Management Corporation
2424 Exbourne Ct.
Walnut Creek, CA 94596

Critical Thinking Program

MaxThink, a program for the IBM PC and compatibles which provides commands for high-level thinking processes such as analysis, synthesis, and evaluation, has been introduced by MaxThink, Inc.

The software uses commands for organizing, analyzing, evaluating, planning, and thinking about information.

The suggested retail price is $60. It requires 192K of memory.

MaxThink, Inc.
230 Crocker Ave.
Piedmont, CA 94610

Personal Productivity Software

Arrays, Inc./Continental Software has introduced several personal productivity software packages for Apple and IBM computers, including:

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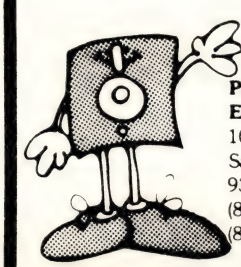

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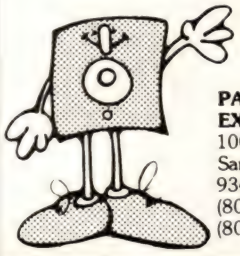

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and *Learn to Type*, a typing program, have been released for the IBM PC and PCjr computers.

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Apple Computer, Inc. has announced an enhanced version of its *Apple Writer II* word processing program.

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P.O. Box 306
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Test-Writing Programs For Apple, 64

Southern Oregon Video Enterprises, Inc. has introduced *SOVE Test Writer* and *SOVE Tester*, two test-writing programs for educators, for Apple and Commodore 64 computers.

Test Writer is menu-driven and allows teachers to format questions and store them in files. Up to 250 questions per file can be stored, and up to eight files per disk can be formatted.

Files generated by *Test Writer* can be used by *Tester*, a program which allows the generation of self-tests on a given topic with questions selected by the instructor.

Suggested retail price for *Test Writer* is $99.95. *Tester* retails for $39.95.

Computer Division
Southern Oregon Video Enterprises, Inc.
P.O. Box 400
Ashland, OR 97520

Atari 600XL Memory Expansion

An expansion module which can add up to 64K of memory to Atari 600XL computers has been announced by RC Systems, Inc.

The module plugs directly into the back of the computer and will not interfere with program cartridges. The AM64 is compatible with the *Atari Translator Disk.*

Model AM2 adds 32K of memory and retails for $79.95; the AM1 adds 48K and has a suggested price of $99.95. The AM64, which increases the memory by 64K, retails for $119.95.

RC Systmes, Inc.
121 West Winesap Rd.
Bothell, WA 98012

Commodore 64 Break Dancing

Break Street, a break dancing computer game for the Commodore 64, has been introduced by Creative Software.

As a break dancer, you compete against the Stingrays, a neighborhood gang, in head spins, moonwalks, snaking, and the tut dance moves. Each break dance has its own level of difficulty. For example, if you miss a key sequence move, your character will fall, turning the action over to the Stingrays. Entire dance sequences may be strung together, recorded, and replayed later.

The game is controlled by either the keyboard or a joystick and sells for a suggested $24.95 on disk.

Creative Software
230 East Caribbean Dr.
Sunnyvale, CA 94089

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Advertisers Index

Reader Service Number/Advertiser	Page
102 Abacus Software	91
103 Abacus Software	93
104 Abacus Software	95
AB Computers	67
105 American PEOPLE/LINK	87
106 Apropos Technology	4
Batteries Included	21
Batteries Included	57
107 Cardco, Inc.	IBC
108 CodeWriter	46
Commodore	BC
109 CompuServe	27
ComputAbility	64
110 Computer Mail Order	80,81
111 Computer Novelty Corp.	142
112 Cosmic Computers	157
113 Davidson & Associates	1
114 Discwasher	7
115 Disk World!	159
Eastman Kodak Company	2,3
Electronic Arts	41
Epyx	51
Epyx	53
Epyx	55
Fidelity Investors Xpress	108
Frontrunner Computer Industries	151
Happy Computers, Inc.	104
116 Harmony Video & Computers	142
IBM	14,15
117 Indus Systems	59
Infocom, Inc.	22,23
118 Inforunner Corporation	IFC
Jason-Ranheim	28
Jesse Jones Ind.	116
119 John Wiley & Sons, Inc.	54
120 J & R Music World	122
121 Krell Software Corp.	156
122 Legend Peripheral Products	107
123 Lyco Computer Marketing & Consultants	154,155
Maxell Corporation of America	11
124 MegaSoft Limited	89
125 Micro-W Distributing, Inc.	128
126 Micro-W Distributing, Inc.	133
127 Micro World Electronix, Inc.	122
128 Micro World Electronix, Inc.	142
129 Mimic Systems, Inc.	35
130 Mindscape, Inc.	25
131 Mindscape, Inc.	43
Navarone Industries, Inc.	156
132 Nibble Notch Computer Products	122
NRI Schools	83
133 Okidata	19
134 Pacific Exchanges	153
134 Pacific Exchanges	156
135 PE Systems, Inc.	158
136 Practical Programs	133
137 Protecto Enterprizes	74,75
137 Protecto Enterprizes	76,77
138 Quinsept, Inc.	46
139 Scarborough Systems	49
140 Sega Enterprises, Inc.	47
141 Smart Data Inc.	83
Spinnaker	9
142 Strategic Simulations, Inc.	29
143 subLOGIC Corporation	37
144 Tape World	158
Terin Software	158
145 Timeworks, Inc.	13

COMPUTE! Books New Releases	31
COMPUTE!'s First, Second & Third Book of Commodore 64	61
COMPUTE!'s Home Computer Wars	33
COMPUTE!'s Machine Language for Beginners & Second Book of Machine Language	63
COMPUTE! Subscription	17

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135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151
152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168
169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185
186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202
203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219
220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236
237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253

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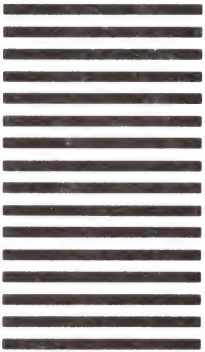

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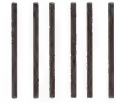

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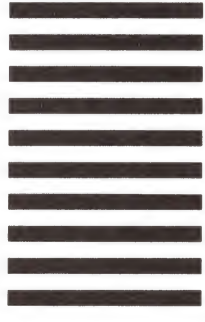

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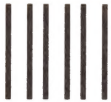

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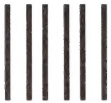

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